electronics

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In this issue, ELECTRONICS tells what our industry is doing to modernize production and test equipment, plant layout and manufacturing techniques—and what remains to be done

A SPECIAL REPORT FROM McGRAW-HILL TO AMERICA'S BUSINESS EXECUTIVES

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Model 500B is a rugged, precision instrument widely used for direct-reading laboratory or production line measurements of ac frequency from 3 cps to 100 KC. With -*hp*- 508A-D Tachometer Generators or -*hp*- 506A Optical Tachometer Pickup, the 500B also provides direct tachometry readings.

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Model 500B has an expanded scale feature permitting any 10% or 30% of selected range to be viewed full scale. It also offers a pulse output synchronous with an input pulse for measuring FM components of input signals or syncing a stroboscope or oscilloscope. Readings are independent of line voltage, input signal or vacuum tube variations. $285.00.

-*hp*- 500C Electronic Tachometer Indicator

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NO MECHANICAL CONNECTION

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MECHANICAL CONNECTION

-hp- 508A/B/C/D Tachometer Generators are for use with electronic counters or frequency meters in rpm measurements from 15 to 40,000 rpm where direct mechanical connection can be made to the rotating part under measurement. -*hp*- 508A produces 60 output pulses per shaft revolution. When connected to an indicating instrument calibrated in rps, it permits direct readings in rpm. Relationship between output voltage and shaft speed is virtually linear to 5,000 pps, simplifying oscilloscope presentation of shaft speed as a function of time for analyzing clutches, brakes and acceleration rates.

-hp- 508B, C and D are identical to -*hp*- 508A except output is 100, 120 and 360 pulses per revolution respectively, and output voltage peaks at successively slower shaft speeds. -*hp*- 508A, B, C or D, $100.00.

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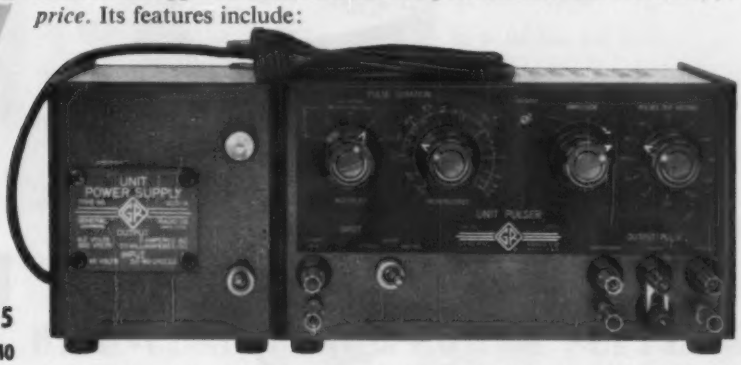

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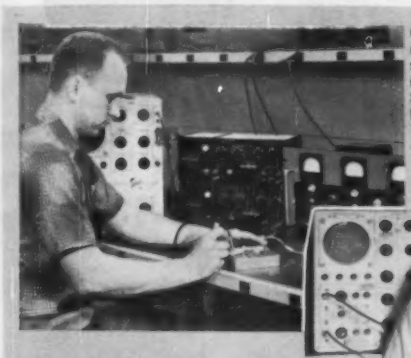

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Photo: Del Mar Engineering Laboratories of Los Angeles, California

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Photo: General Telephone Laboratories, Inc., of Northlake, Illinois

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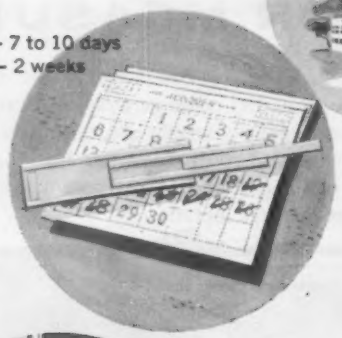

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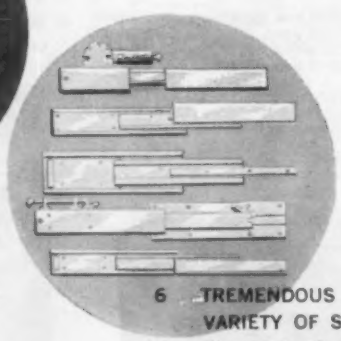

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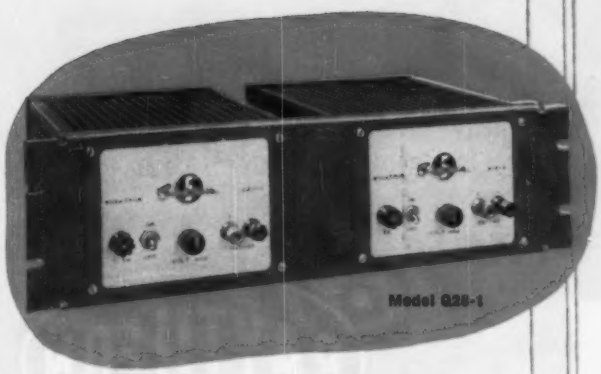

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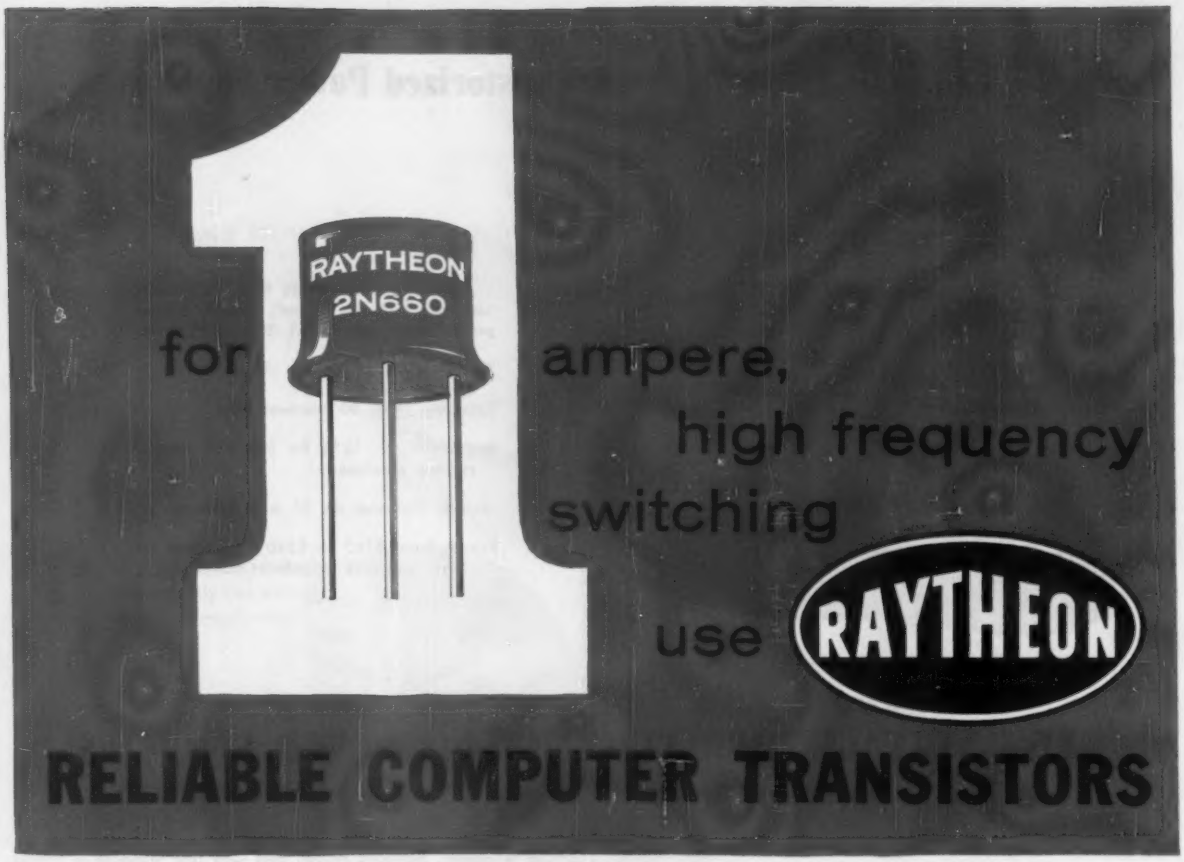

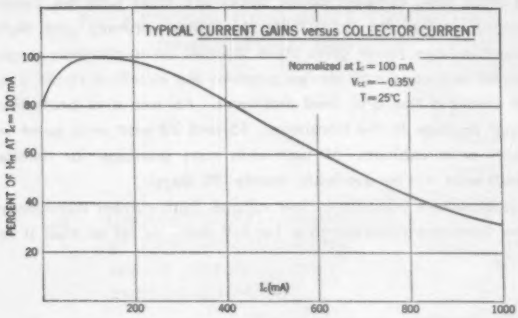

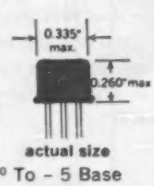

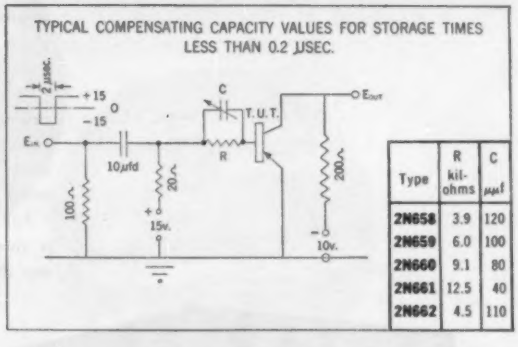

Type	R kil-ohms	C μμf
2N658	3.9	120
2N659	6.0	100
2N660	9.1	80
2N661	12.5	40
2N662	4.5	110

Type	Punch through Voltage max.	f_{ab} ave. Mc	H_{FE_1} ave. I_B = 1 mA V_{CE} = −0.25v	H_{FE_2} ave. I_B = 10 mA V_{CE} = −0.35v	I_{CO} at −12v μA	r_b' I_C = −1mA ohms	C_{ob} V_{CB} = −6v μμf
2N658	−24	5	50	40	2.5	60	12
2N659	−20	10	70	55	2.5	65	12
2N660	−16	15	90	65	2.5	70	12
2N661	−12	20	120	75	2.5	75	12
2N662	−16	8	30 min.	50	2.5	65	12

Typical values at 25°C unless otherwise indicated

Dissipation Coefficients: In air 0.35°C/mW; Infinite Sink 0.18°C/mW

These new PNP Germanium Computer Transistors made by Raytheon's reliable *fusion-alloy* process add to the already comprehensive line of Raytheon Reliable Computer Transistors which include several in the *Submin* (0.160″ high, 0.130″ dia.) package. Write for Data Sheets.

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ELECTRONICS NEWSLETTER

IMPROVED PROCESSING OF MATERIALS is being pushed strongly by the electronics industry right now. Sylvania's dedication this month of its new engineering, research and development laboratory in Towanda, Pa., underscores this trend. Firm also pointed to importance of modern X-ray diffraction and spectrographic equipment in advanced development work. It indicated special attention is being given to production of:

- **Silicon and germanium** for transistors and other semiconductor devices. Company sees sales of devices made from these semiconductor materials rising to $1 billion by 1965.

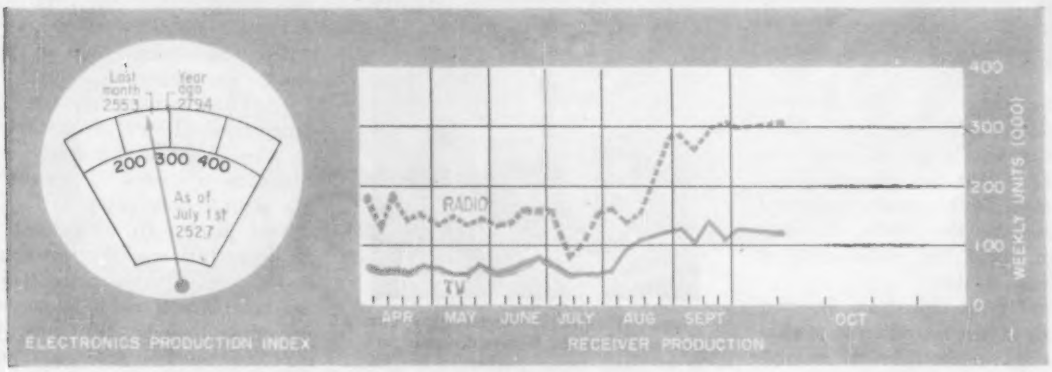
- **Molybdenum** for use in electronic components such as the rigid parts of electron tubes, and electrodes for arc melting, plus missile applications. Sylvania is experimenting with a new method of casting molybdenum in ceramic molds.

- **Tungsten** for use in various kinds of tubes and other possible applications in space vehicles. Miniature components are demanding more and more efficient processing of tiny wires.

- **Phosphors** for tv picture tubes, electroluminescent panels, radar screens and lamps. New Towanda facility has mechanized stoking unit for pilot production that's operated by one man; processing speed can be regulated according to demand for phosphors. Development work makes use of new custom-made ultraviolet emission excitation radiometer; it measures spectral energy distribution of phosphors under different types of excitation.

SOVIET INDUSTRIAL MODERNIZATION is slowed by inadequate control instruments, according to a recent speech by the chief engineer of a chemical plant. Decrying the lack of high-precision regulators and density-measuring gear, he said this had held up complete automatic processing in his plant. He complained that (1) chemical plants were not being supplied with explosion-free shutoff devices; and (2) that of 234 regulators scheduled for delivery last year at his plant, only 22 arrived. He called for integrating instrument designers at Soviet plants for on-the-spot design work. As for television:

- **Closed-circuit tv** production is being pushed. Remote control vidicon system with monitor and six receivers is being used for railroad switching, at hazardous locations like atomic installations and for medical uses. It's a good bet this will be a fast-growing electronic item in Russia since it ties in with automation plans.



FIGURES OF THE WEEK

RECEIVER PRODUCTION

(Source: EIA)	Oct. 3, '58	Sept. 26, '58	Oct. 4, '57
Television sets, total	121,495	128,358	167,605
Radio sets, total	309,574	305,230	356,748
Auto sets	103,299	101,196	114,402

STOCK PRICE AVERAGES

(Source: Standard & Poor's)	Oct. 8, '58	Oct. 1, '58	Oct. 9, '57
Radio-tv & electronics	60.36	59.52	43.74
Radio broadcasters	71.02	69.55	54.20

FIGURES OF THE YEAR

Totals for first eight months

	1958	1957	Percent Change
Receiving tube sales	251,657,000	297,281,000	—15.3
Transistor sales	25,310,834	15,611,300	+62.1
Cathode-ray tube sales	4,952,862	6,236,890	—20.6
Television set production	2,950,455	3,756,533	—21.5
Radio set production	6,611,686	8,765,606	—24.6
TV set sales	2,862,452	3,746,794	—23.6
Radio set sales (excl. auto)	4,111,080	4,947,006	—16.9

MORE FIGURES NEXT PAGE

PLAN '59

Shiny new work areas, like this precision assembly room at Kearfott, create impression that . . .

Few Plants Are Obsolete

Rise of electronics industry during last decade makes its production facilities newer than average. But much remains to be done

ELECTRONICS INDUSTRY'S growth in the last decade—this year's $8-billion in factory sales is more than double 1948 sales—has made the tools and factories of our industry newer than the average American plant. But much remains to be done towards effective modernization.

The impression ELECTRONICS editors got while gathering material for this week's special report (see p 73) is that the industry is still not ready for the upsurge in demand forecast for the 1960's. In some plants, only the architecture is really up to date.

Some firms indeed are investing heavily in mechanization of production facilities, both for the immediate advantage and the long run. They are taking advantage of new tools and techniques. Those who are successfully using mechanization report that without it they could not even withstand the effects of today's increased labor and plant space costs.

Frequency-controlled metal spray gun fine-tunes crystals. Bulova design is part of automatic crystal production line for Signal Corps

But the trend away from traditional manufacturing concepts is by no means universal. What is required, according to one firm practicing short-run mechanization, is a systems approach. The full value of mechanization on the production floor can only be realized if product research, design and marketing are geared to mechanized standardization, a basic requirement of mechanized production. Product stability can be enhanced by designs using modular circuits or similar components.

For many firms, modernizing their test equipment has an immediate payoff. A military contractor's ability to adequately test his product is considered by many military purchasers to be as important as the equipment used to put the product together.

Here's how one West Coast manufacturer describes his plant's modernization program: "We use most of our ingenuity in developing flexibility and special go, no-go test equipment. It is in testing equipment that the human factor becomes least dependable—and where faulty equipment can cost more than any possible savings in direct manufacturing and labor."

About one-third of the production equipment in the electronics industry is over 10 years old, compared with a proportion of two-thirds for American industry at large. Plant by plant, however, the proportion of 10-year-old machinery in the electronics industry was found to vary from 90 percent in one plant to none in others.

One plant with 90 percent of its production machinery over age, and another with 50 percent over age, were both found to be producing substantially less than might be expected, based on square-foot area

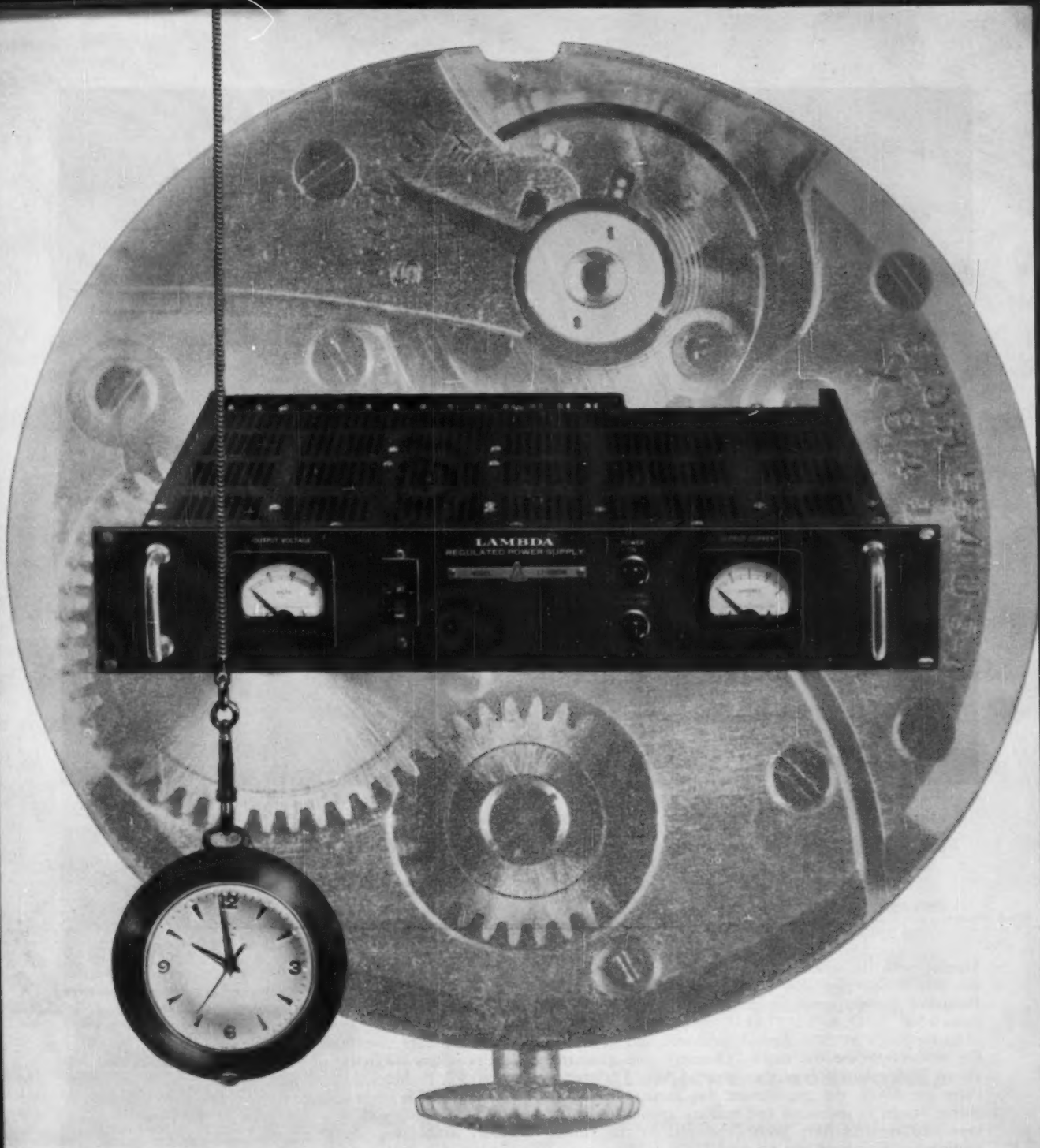
(Continued on page 12)

TRANSISTOR AND TUBE SALES, MONTHLY

(Source: EIA)	Aug., '58	July, '58	Aug., '57
Transistors, units	4,226,616	2,631,894	2,709,000
Transistors, value	$9,975,935	$6,598,762	$6,598,000
Receiving tubes, units	30,456,000	30,795,000	43,029,000
Receiving tubes, value	$25,442,000	$26,927,000	$34,886,000
Picture tubes, units	713,458	549,817	930,296
Picture tubes, value	$14,190,878	$11,109,048	$17,984,185

EMPLOYMENT AND EARNINGS

(Source: Bur. Labor Statistics)	July, '58	June, '58	July, '57
Prod. workers, comm. equip.	339,400	339,700	395,600
Av. wkly. earnings, comm.	$81.35	$82.39	$75.85
Av. wkly. earnings, radio	$80.99	$81.60	$75.05
Av. wkly. hours, comm.	39.3	39.8	39.1
Av. wkly. hours, radio	39.7	40.0	39.5



Guaranteed: around-the-clock performance for five years

Freedom from worry about major maintenance or extensive replacement for *five full years.* That's the guarantee given with every Lambda power supply—the first such guarantee in the electronics industry. It proves the point engineers keep making in preference studies: When operating conditions make dependability a "must," they specify Lambda...
To check the full Lambda line yourself, send for the latest catalog.

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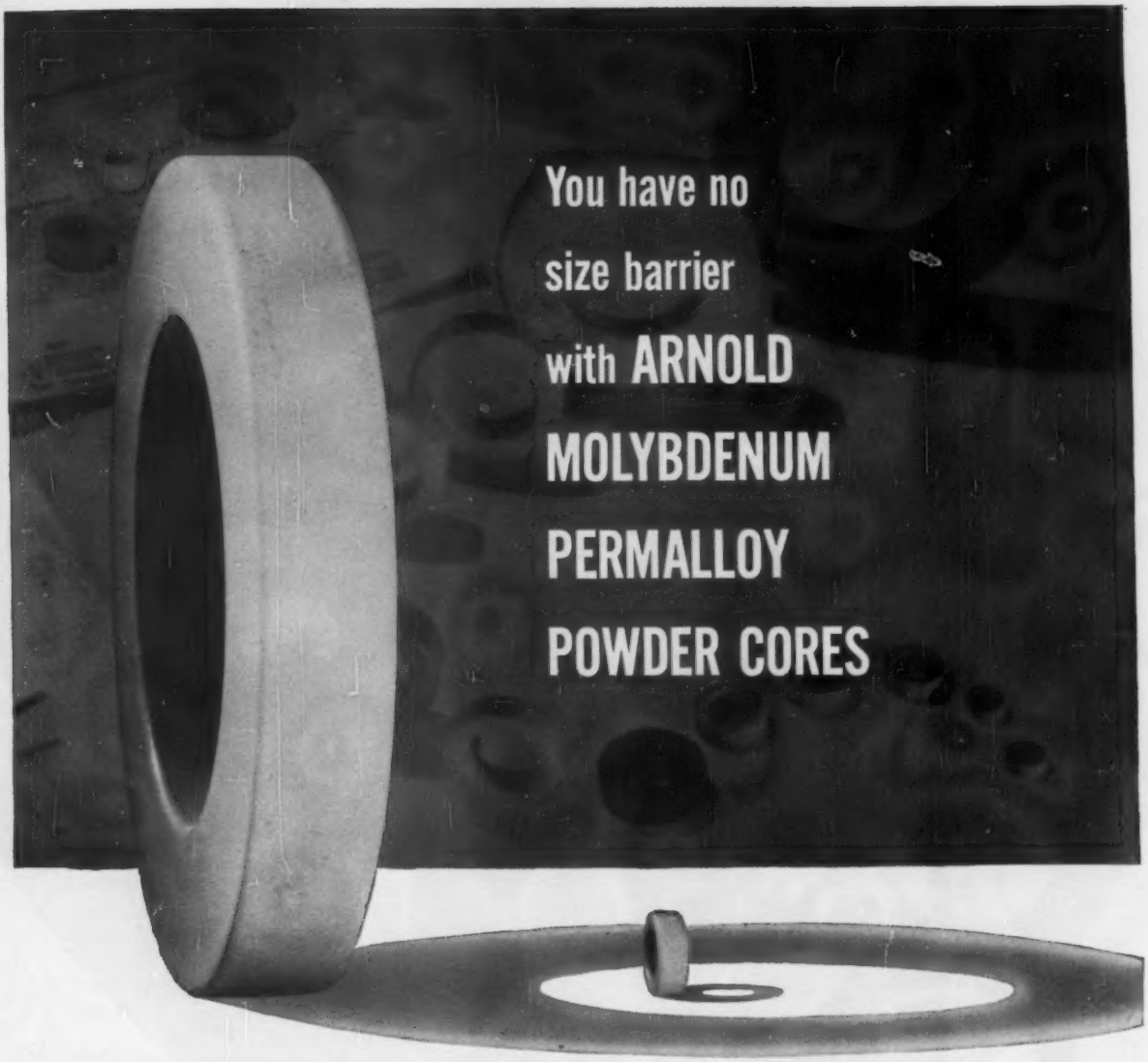
CIRCLE 5 READERS SERVICE CARD



Starting with the smallest up to the largest, Arnold leads the way in offering you a full range of Molybdenum Permalloy Powder cores for greater design flexibility . . . from 0.500" O.D. to 5.218" O.D.

As long ago as 1953 Arnold pioneered and developed for production use the small "Cheerio" core illustrated above. Today, hundreds of thousands of Arnold "Cheerio" cores are filling the requirement for miniaturization in circuit design in industrial and military applications. And even smaller sizes have been developed by the Arnold Engineering Company and are available.

Arnold also is the exclusive producer of the largest 125 Mu core commercially available. A huge 2,000 ton press is required for its manufacture and insures its uniform physical and magnetic properties. This big core is also offered in the other three standard permeabilities of 60, 26 and 14 Mu.

Most core sizes can be furnished with a controlled temperature coefficient of inductance in the range of 30° F to 130° F. Many can be supplied temperature stabilized over the wide range covered by the MIL-T-27 specification of −55° C to +85° C . . . another of the special features only Arnold provides. ● Let us handle all your magnetic materials requirements from the most extensive line in the industry: Powder cores, tape cores, cast or sintered Alnico permanent magnets, and special magnetic materials.

WSW 6901 A

For more information write for Bulletin PC-1048

Lists complete line of Mo-Permalloy Powder cores . . . available in 23 sizes from 0.500" O.D. to 5.218" O.D. Furnished also with various types of temperature stability from Type "A" unstabilized to Type "W" stabilized over the temperature range of −65° F to +185° F.

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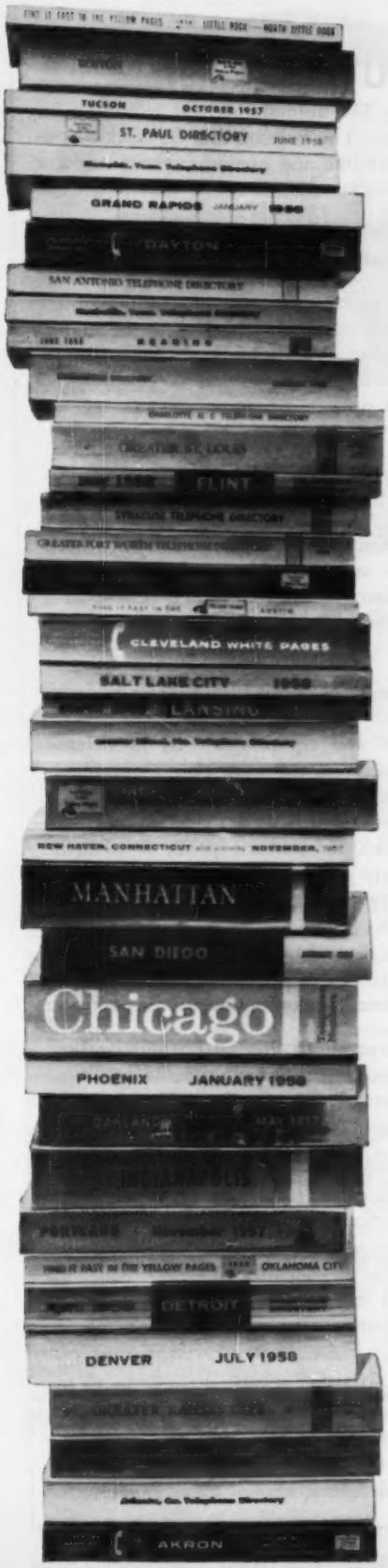


1 in 35,000,000

How the telephone switching system sorts numbers in seconds

When you dial out of town, the telephone switching system performs an amazing feat. It sorts out the one other number in 35 million you want, and connects you to it in seconds. The other telephone may be thousands of miles away.

Bell Laboratories engineers endowed this great switching network with almost superhuman capabilities. As you dial, the machine listens, remembers, figures out the best route, makes connections, alerts, reports, even corrects itself. If it detects trouble on the way, it files a report, then chooses other circuits and goes on to complete your call. All you are aware of is the end product—the completed call.

Yet at Bell Telephone Laboratories, switching engineers see the present system as only a beginning. Ahead they see—and are developing—new systems vastly more flexible and capable than today's. Nowhere in telephone technology is the challenge greater. Nowhere are dreams coming true faster.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

These Bell Telephone System directories list some of the 35,000,000 telephones now linked by the Direct Distance Dialing system developed at Bell Laboratories. In seconds, this unique machine sorts out and connects you with precisely the number you want.

and number of employees.

One firm related the difficulty it had in holding parts to required tolerance with its production machinery. In such a case, where meeting tolerances proves difficult, the alternatives to new machinery purchase are revision of product specifications, job-shop parts purchasing or increased product cost through higher reject rates.

Economics Slows Updating Abroad

FOREIGN ELECTRONICS plant growth and use of new gear and techniques has been rapid in the last decade. However, a spot check just made by ELECTRONICS of engineers and executives familiar with overseas operations discloses these general feelings:

- American production techniques are being widely emulated, less often matched in results.
- In the fields of consumer electronics and communications equipment, neither Western Europe, Japan nor the Soviet Union come close to the degree of mechanization found in the U. S. electronics industry.
- Modernization of consumer electronic production in the Soviet Union is hampered by wide use of old buildings for plants, even though much of the equipment inside is new.
- Lack of a huge volume demand for consumer electronic products in Western Europe will hold in check any ideas for mechanizing assembly for some time to come, despite the existence of new physical plants that might be used for this purpose.

One U. S. executive of a firm with overseas interests contrasts the economics of electronics plant modernization this way: Productivity factor per worker in the U. S. electronics industry is based on advanced manufacturing facilities. In Japan, and even in Western Europe, many hands are often more economical than one machine.

This observer also cites the attitude of labor abroad. He says in many plants overseas, this attitude permits worker incentives, usually

WASHINGTON OUTLOOK

THE PENTAGON will spend roughly $15 million this year to modernize military-owned production facilities. The bulk of this, however, is earmarked for aircraft and missile airframe and engine facilities and for shipbuilding, rather than electronics facilities.

In military spending for production plant and equipment, the emphasis is now on new facilities to produce advanced components and end-items.

For the most part, military expenditures on capital equipment for electronics go for environmental test equipment and similar apparatus.

The military services are now trying to minimize government investment in capital facilities. Says one Pentagon official: "We will spend money only in specialized high-risk projects where we can't get private investment."

- **Washington** has no plans—as of the moment—to stimulate modernization of plant facilities in the electronics industry.

  In general, top-level administration officials are sympathetic toward liberalization of tax and related policies as a spur to capital expenditures by industry. But they don't believe in a significant revision of policy while the economy booms and inflation threatens.

  Washington's attitude toward electronics industry modernization can be summed up this way:

  Since much of the plant and equipment used in defense electronics production is privately owned rather than government-owned (as in military aircraft production), it is the responsibility of industry to keep privately-owned capacity as modern as possible. Indeed, one trend in military procurement policy is to favor contractors who do not require government-financed facilities.

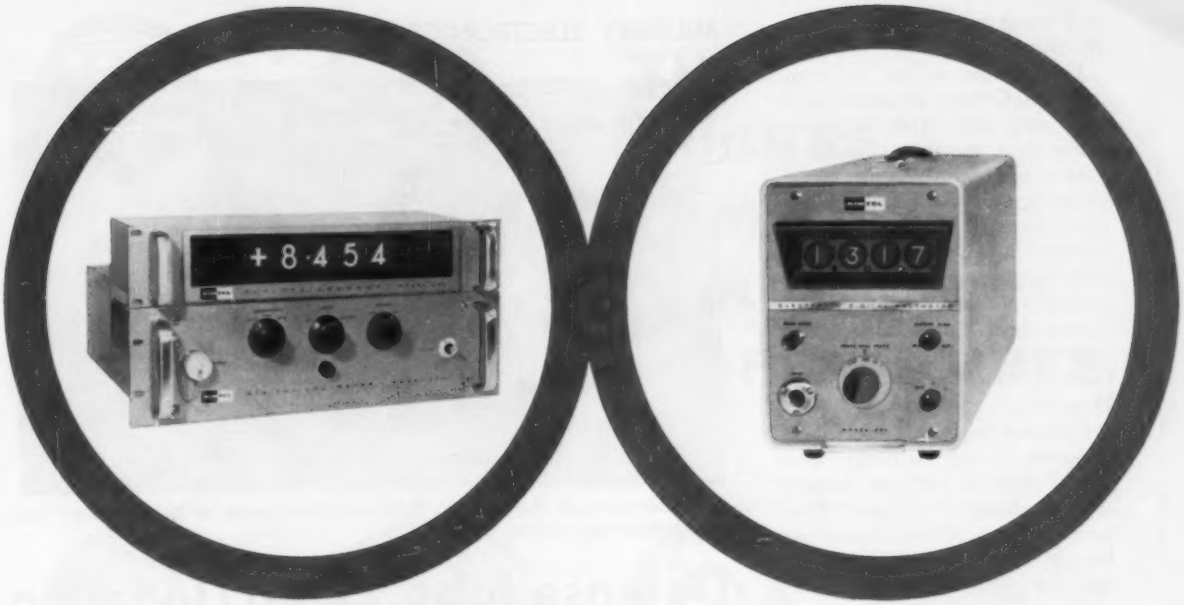
  The 1954 tax law—with its two new options for tax depreciation—provides faster rates of writeoff. The dollar advantages of the new "double-declining-balance" and "sum-of-the-digits" depreciation methods are substantial enough to encourage widescale plant and equipment replacement, Washington officials believe.

- **The government** still allows special accelerated tax amortization privileges for privately financed expansion of defense facilities. But this program has been slowed down by the 1957 changes in the tax law and by narrowing defense expansion objectives.

  Under the new rules, five-year defense tax-writeoffs are granted only on new production facilities for products which were developed or placed in production after January 1957.

  As it shapes up now, fast tax-writeoff policy stresses R&D facilities which have a direct relationship to military needs.

- **The Internal Revenue Service** is expected to issue soon a revised edition of its Bulletin F, which sets up useful lengths of life for tax deduction purposes on most types of capital equipment. In general, the new rules will further liberalize the tax system by reducing the life of equipment, thus boosting annual deductions. Insiders caution, however, that for some machines, the trend will reverse—extending the life and cutting allowable tax deductions.



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DC digital voltmeter offers maximum reliability... 0.01% accuracy... single-plane readout... and many other advanced features

The Model 401 offers four-digit display with automatic polarity indication and decimal placement... Measures .0001 to 999.9 volts with 0.01% ±1 digit accuracy... Adjustable least digit sensitivities of .1, 1, 10 mv... Average reading time of one second... Continuous, automatic standard cell calibration... 10 megohms input impedance... Built-in printer drive... 10 times longer readout bulb life... No circuitry in readout for easy remote mounting... Extra long relay life assured by DC drive. Price: $2100.

KIN TEL manufactures an exceptionally complete line of digital instruments. These "digital building blocks" permit measurement of AC, ohms, ratios, and automatic scanning of multiple inputs. Preamplifiers increase digital voltmeter sensitivity to 1 microvolt DC and 10 microvolts AC. Buffers permit driving typewriters, tape punches and printers. Complete digital systems for data logging, missile checkout and production testing are also available. The reliability and accuracy of these precision instruments are assured by KIN TEL's experience in designing and manufacturing more than 10,000 "standard cell accuracy" DC instruments. Sales and service are available nationwide. KIN TEL Engineering Representatives in all major cities.

All-electronic digital voltmeter measures millivolt to kilovolt with 0.1% accuracy ...costs only $960

Four ranges: 0.000 to 1.599; 00.00 to 15.99; 000.0 to 159.9; 0000. to 1000 volts (manual ranging and polarity)... No moving parts... Digital in-line readout... 70 millisecond conversion time... Adjustable display time... Input completely floating and isolated... 0.1% of full scale accuracy ... Direct voltage conversion circuit... Wide range of models.

KIN TEL's Model 801A all-electronic digital voltmeter measures DC from 0.001 to 1000 volts with 0.1% of full scale accuracy... and in less than 1/10 second, presents the measured voltage clearly on an in-line digital readout that even unskilled personnel can read with ease. *Direct* voltage measurement by successive approximation provides accuracy and sensitivity previously obtainable only in delicate, complex and expensive instruments. Extremely stable operation – continuous calibration against an internal reference. (Input impedance of the Model 801A is 20,000 ohms per volt. The Model 802A, priced at $1190, has an input impedance of 10 megohms on all ranges. In other models, the binary coded decimal and decimal outputs are externally available to permit driving printers and tape punches.)

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on a group basis, which boost productivity.

For example, he said, a "team" in a West German communications plant may earn 20 to 30 percent above their guaranteed wage. As long as such firms produce quality products that are competitive in world markets, they are not likely to invest heavily in automatic manufacturing gear, he argues.

Most of the engineers interviewed about European electronics modernization singled out West Germany for special comment. Here's why:

Electrical engineering-electronics companies found themselves after World War II with the liability and opportunity of lost plant. They have rebuilt, shifted operations from Berlin and built anew in other parts of West Germany, with equipment inside to match in modernity.

A solid 50 percent of present equipment is less than five years old and only 20 percent is more than 20 years old. Last year's production index was 17 times what it was in 1936; the industry is investing more than $200 million annually and sees no end to its boom.

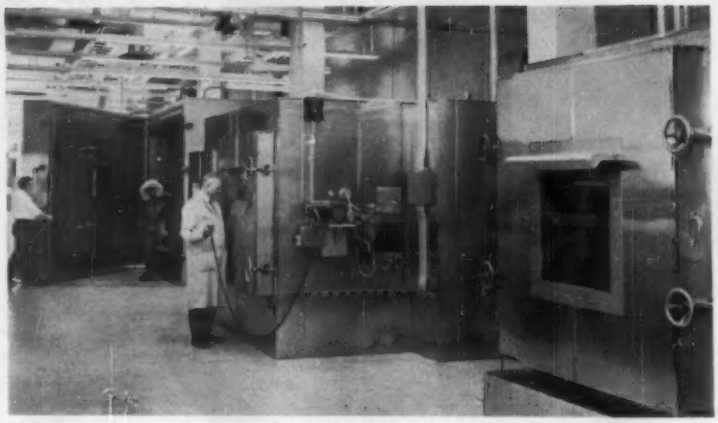
Signs of continuing modernization trend: growing use of printed circuits and steps towards automation in electron-tube production. Continuing investment emphasizes more efficient yield, but there's still resistance to change from tried-and-true methods.

In the Soviet Union, keyed to rapid expansion of consumer goods, the manufacture of radio and tv sets involves much more hand labor than in the U. S., along with worker incentives to raise productivity.

An observer saw one tv set subassembly this year that looked somewhat like a printed circuit with connections made by solder-dipping.

Production is reported to be hampered by old buildings with facilities scattered on several floors. Spending for new plants for civilian electronics manufacture has apparently been held in abeyance because of the priority that consumer products themselves have over modernization of industry.

MILITARY ELECTRONICS



Environmental test chambers for B-70 bomb-nav system at IBM's Owego plant were bought on a facilities contract

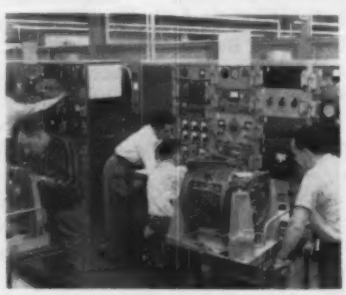
Defense Jobs Speed Updating

Government incentives provide military product plants with good modernization opportunities

Modernization of military product plants, facilities and special equipment has progressed rapidly for two equally good reasons: the specialized nature of the products requires tailor-made facilities, tooling and extremely precise test gear; also, a large portion of this modernization is paid for by the government.

There are several ways in which government incentives to manufacture military products offset the relatively low profit derived from military contracts, as compared to profit from commercial work.

Low capital expenditures is one of the major incentives. A company may build and equip a plant with government money. After the contract is completed and depreciation figured, the firm may then buy plant and equipment.



Special test gear, designed and built by Sperry for B-58 bomb-nav system, is government property

Some firms buy their own plants but take advantage of the fast-writeoff incentive system by which the government allows a large portion of the plant's cost to be amortized in depreciation over the first five years.

This incentive is only granted in special cases for a highly specialized product that might never go into large-scale production. Low profit is thereby offset by acquisition of a plant or laboratory with unusual tax writeoff.

Other companies choose to build and equip—except for a few items—their own plants. The exception is specific, one-shot equipment—usually test gear—that will never be needed for another contract. This is acquired as GFE—government furnished equipment.

"Having been in the military business for a long time, we take the long view," says one company official. "We prefer to build our own plants and, as much as possible, buy our own equipment."

One good reason to update facilities, according to one large military contractor, is the fact that 80 percent of government military con-

...applied to weather radar

MAGNETIC DEFLECTION 5" DIAMETER

Representative applications: plan position indicator information; slow-scan television. (Complies with Aeronautical Radio, Inc. specifications.)

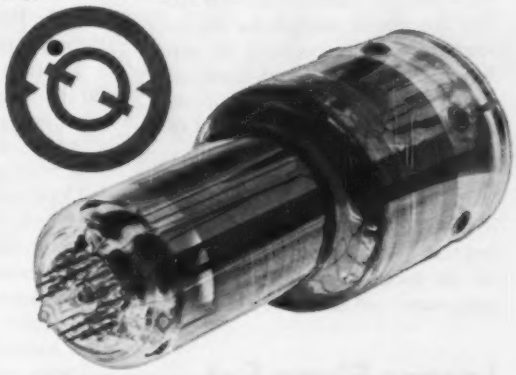
THE HUGHES FAMILY OF TONOTRON* DISPLAY TUBES

...applied to slow-scan television

ELECTROSTATIC DEFLECTION 5" DIAMETER

Representative applications: "B" scan radar, oscillography, armament control radar.

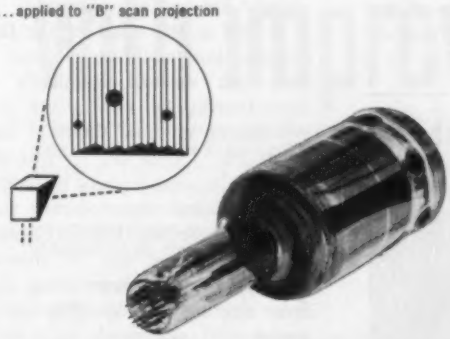
...applied to complex radar systems



ELECTROSTATIC DEFLECTION 5" DIAMETER

With two writing guns. Representative applications: multiple "B" scan radar, oscillography, and armament control radar.

...applied to "B" scan projection



ELECTROSTATIC DEFLECTION 3" DIAMETER

Representative applications: optical projection systems, miniature radar indicators.

High brightness, multiple halftones, superior storage uniformity, controllable persistence, and compact design are the outstanding characteristics of the Hughes TONOTRON electron tube. All TONOTRON tubes present a complete scale of grey shades for high-fidelity picture reproduction. Hughes offers the only complete line of cathode-ray storage tubes, including the infinite persistence tubes—TYPOTRON® Type 6577 (character-writing storage tube) and the MEMOTRON® Type 6498 (oscillograph storage tube).

Complete technical information—specifications, operating characteristics, suggested circuitry, etc., will be sent you on request. Write: HUGHES PRODUCTS, Marketing Department, International Airport Station, Los Angeles 45, California.

Creating a new world with ELECTRONICS

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tracts are awarded on the basis of technical ability rather than on bids alone.

Specialized equipment, relating specifically to fulfilling a contract, is often provided by the government in one of several ways: the government may own the hardware outright and lend it to the company; the government may award a facilities contract to the company to buy or build the equipment. In both cases, on completion of the contract, the equipment is either returned to the government for storage, transferred to another company, or, in some cases, bought by the company for future use.

If the contractor foresees a future use—possibly commercial—for special equipment needed for an immediate military contract he may buy the equipment with company funds. Some of the cost of the equipment can then be charged off to the government for depreciation during the life of the contract.

Regardless of how equipment is obtained, military contractors say military work keeps the company on its toes, keeps the plant and equipment out in front.

Larger Firms Set West Coast Pace

LOS ANGELES—Consensus of West Coast manufacturers is that greatest dollar expenditures for modernization of production, research, and test facilities in 1959 will be made by firms with annual sales of $40 million and up.

The small-to-medium-sized companies, still retrenching, will spend more cautiously.

Chamber of Commerce figures indicate that expenditure for expansion and modernization of existing firms is running about 10 times that of capitalization of new firms.

Projection of these figures places the 1959 total outlay around the $30-million figure. This includes land, construction, new equipment.

Because of increasing emphasis on reliability and more exacting performance demands, it is predicted that a higher-than-usual percentage of modernization capital will go for complex test equipment.

FINANCIAL ROUNDUP

Financing for Tomorrow

There's modernization money in depreciation reserves, earned surplus, stock issues, debentures and direct loans

Modernizing an electronics plant is one thing. Finding money for it is another. Today both can be done.

Modernization money can come from two sources:

- It can be generated internally by making sales and earning profits.
- It can be supplied from the outside through sale of equity or through creation of a debt.

Internally-generated money is by far the largest source of funds for gear buying. The money comes along two broad avenues—depreciation reserves and earned surplus.

Depreciation is the estimated annual cost of wear and exhaustion of plant and equipment. Because it is a noncash expense, depreciation conserves cash by decreasing net profits before income taxes, thus reducing income tax liability.

Depreciation reserves provided most of money to purchase new plant and equipment between 1953 and 1957. U.S. corporations invested about $135 billion. About $74 billion, 54 percent, from accumulated depreciation.

For all U. S. industry annual depreciation charges averaged just under 3 percent of sales in recent years. Sampling of records of electronics firms indicates depreciation charges in the electronics industry have been smaller than in industry generally, but still considerable. In the average electronics firm the annual depreciation charge is about 2 percent.

Management decisions on depreciation methods can markedly affect the amount of cash conserved.

About a year ago IBM reduced reported net income after taxes for 12 months by about $6 million and achieved a tax saving in neighborhood of $3 million through election of one of the rapid depreciation methods now available.

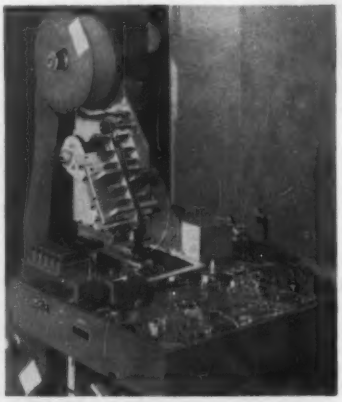
Since 1954 it has been permissible for income-tax purposes to calculate depreciation charges by two accelerated methods: the sum-of the years-digits or the declining-balance. Previously, only the straight-line way was allowed.

If one or the other of the fast-depreciation methods is used, a firm can recover two-thirds to three-fourths of new plant and equipment cost in the first half of its life. Under the straight-line method the same amount is charged each year and always equals that portion of asset life that has elapsed.

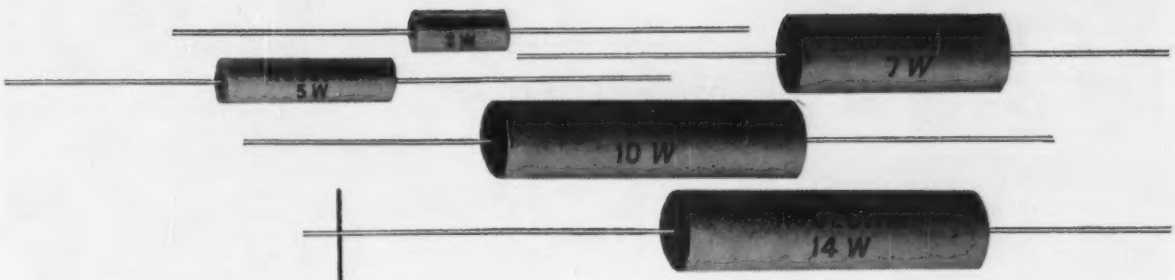
Net effect of use of sum-of-digits or declining-balances is that firms electing them get free use of government money through extra depreciation allowances in early years. Also, the effects of inflation and rising prices are not felt quite so keenly. However, these advantages in early years are offset by lower depreciation allowances in later years. (For further details on the subject see Electronics, p 9, Sept. 10, 1957.)

Until recently many electronics firms have not been interested in

No-Hands Tester



Diodes are unbelted, run through test positions and rejected or rebelted in new IBM test machine



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with improved performance

Sprague's new smaller size Koolohm Resistors are designed to meet modern industrial requirements for insulated-shell power wirewound resistors that will perform *dependably* under the severe duty cycles encountered in heavy duty industrial electronic equipment.

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1. Leads are welded to drawn metal cap ends.
2. Ceron (ceramic insulated) resistance wire wound under controlled tension on special ceramic core. Makes possible multi-layer non-inductive windings as well as very high resistance value conventional windings.
3. Finished resistance elements are given unexcelled mechanical protection by non-porous ceramic outer shells—sealed with high temperature silicone end cement.
4. Insulated shell permits mounting in direct contact with chassis or "live" components.
5. *Aged on load* prior to final test and inspection to stabilize resistance value and assure outstanding performance on load-life tests!

The advanced construction of these improved Koolohm Resistors allows them to operate at "hottest spot" temperatures up to 350°C. You can depend upon them to carry maximum rated load for any given physical size.

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SPRAGUE COMPONENTS: RESISTORS • CAPACITORS • MAGNETIC COMPONENTS • TRANSISTORS
INTERFERENCE FILTERS • PULSE NETWORKS • HIGH TEMPERATURE MAGNET WIRE • PRINTED CIRCUITS

these fast-depreciation options because of greater advantages offered by certificates of necessity. These certificates allow for depreciation of equipment important to defense needs at an accelerated five-year rate instead of the 10 to 20 years normally allowed. But issuing certificates ends in 1959.

Last year many industry firms learned that a 10-percent drop in sales could mean a 50-percent fall in profits, because of fixed expense items and lags in making reductions in variable expenses.

However, small and moderate-sized sales increases in 1958 will mean substantial profits and beefed-up surplus accounts for many, as expense increases lag behind the sales increases. Depreciation reserves and accumulated earned surpluses are insufficient to meet the modernization needs of many firms.

In a growth industry cash increments melt rapidly. Many firms must raise additional money outside.

In most cases outside sources are well known. But several timely developments spotlight specific money-raising chances.

The stock market presents attractive opportunities for sale of equity through common stock issues. Average stock market prices are at an all-time high and electronics stocks are still among investors' favorites. (See ELECTRONICS, p 5, Oct. 3.)

The Small Business Act of 1958 opens up a whole new avenue for small firms to obtain long-term funds and equity-type financing.

Hundreds of new investment companies organized for the purpose of making this type of loan and investment are expected to be chartered shortly by the SBA.

Last session of Congress passed several laws which present opportunities for industry firms to keep more money in the till.

For equipment purchased after December 31, 1958 and costing no more than $10,000, government has authorized a first-year depreciation writeoff of 20 percent in addition to normal depreciation allowances for the succeeding years.

Small firms are now allowed to use either of two fast-depreciation options for up to $50,000 worth of used equipment.

Modernizing Tops Midwest Projects

CHICAGO—MANUFACTURERS of electronic equipment and component producers are making and will continue to make modernization of their facilities a prime project in 1959.

President John Best of Chicago Telephone Supply sees new research in materials, metals, ceramics.

Zenith Radio's manufacturing vice president, Don MacGregor, says the company may invest a quarter million dollars in its Wincharger subsidiary.

Motorola is planning $2 million worth of new manufacturing, research and test facilities at its semiconductor division in Phoenix, Ariz., and is moving all tv production to one central location at Franklin Park, Ill.

The John Oster Co. of Racine, Wis., will speed up production volume in its new small motor plant in New Ulm, Minn., and is operating four plants in Racine.

Spending Rises In New England

BOSTON—MODERNIZATION for reliability is theme of project at Sylvania's semiconductor products division in Woburn, Mass. More than $200,000 will be spent.

General Radio Co. of Cambridge and Concord, Mass., plans modernization of machine tool inventory and plating room setup.

Rounding out in '59 a $4-million investment in research and production machinery will be Avco's Research and Advanced Development Division in Wilmington, Mass.

Trans-Sonics of Burlington, Mass., plans to have delivered for use in '59 about $50,000 worth of new equipment.

Laboratory for Electronics, Boston, will spend $1½ million for production test gear in '58-'59.

MEETINGS AHEAD

Oct. 26-31: American Institute of Electrical Engineers, AIEE, Fall Meeting, Penn-Sheraton Hotel, Pittsburgh, Pa.

Oct. 27-28: Aeronautical and Navigational Electronics, East Coast Conf., PGANE of IRE, Lord Baltimore Hotel, Baltimore.

Oct. 27-28: Electronic Industries Assoc., EIA Radio Fall Meeting, Sheraton Hotel, Rochester, N. Y.

Oct. 28: Ultrasonic Manufacturers Assoc., Annual Meeting, Hotel Cleveland, Cleveland.

Oct. 29-30: Computer Applications Symposium, Fifth Annual, Armour Research Foundation, Morrison Hotel, Chicago.

Oct. 30-31: Aircraft Electrical Society, Pan-Pacific Auditorium, Los Angeles.

Oct. 30-31; Nov. 1: Electron Devices Meeting, PGED of IRE, Shoreham Hotel, Washington, D. C.

Nov. 6-7: Nuclear Science Meeting, Fifth Annual, PGNS of IRE, Villa Motel, San Mateo, Calif.

Nov. 17-20: Magnetism and Magnetic Materials, Fourth Annual Conf., AIEE, APS, IRE, ONR, Sheraton Hotel, Philadelphia.

Nov. 19-20: Northeast Electronics Research and Eng. Meeting, NEREM, IRE, Mechanics Hall, Boston.

Nov. 19-21: Electrical Techniques in Medicine and Biology, AIEE, ISA, PGME of IRE, Nicollet Hotel, Minneapolis.

Dec. 2-4: Reliable Electrical Connections, Third Annual Conf., EIA, Statler-Hilton Hotel, Dallas.

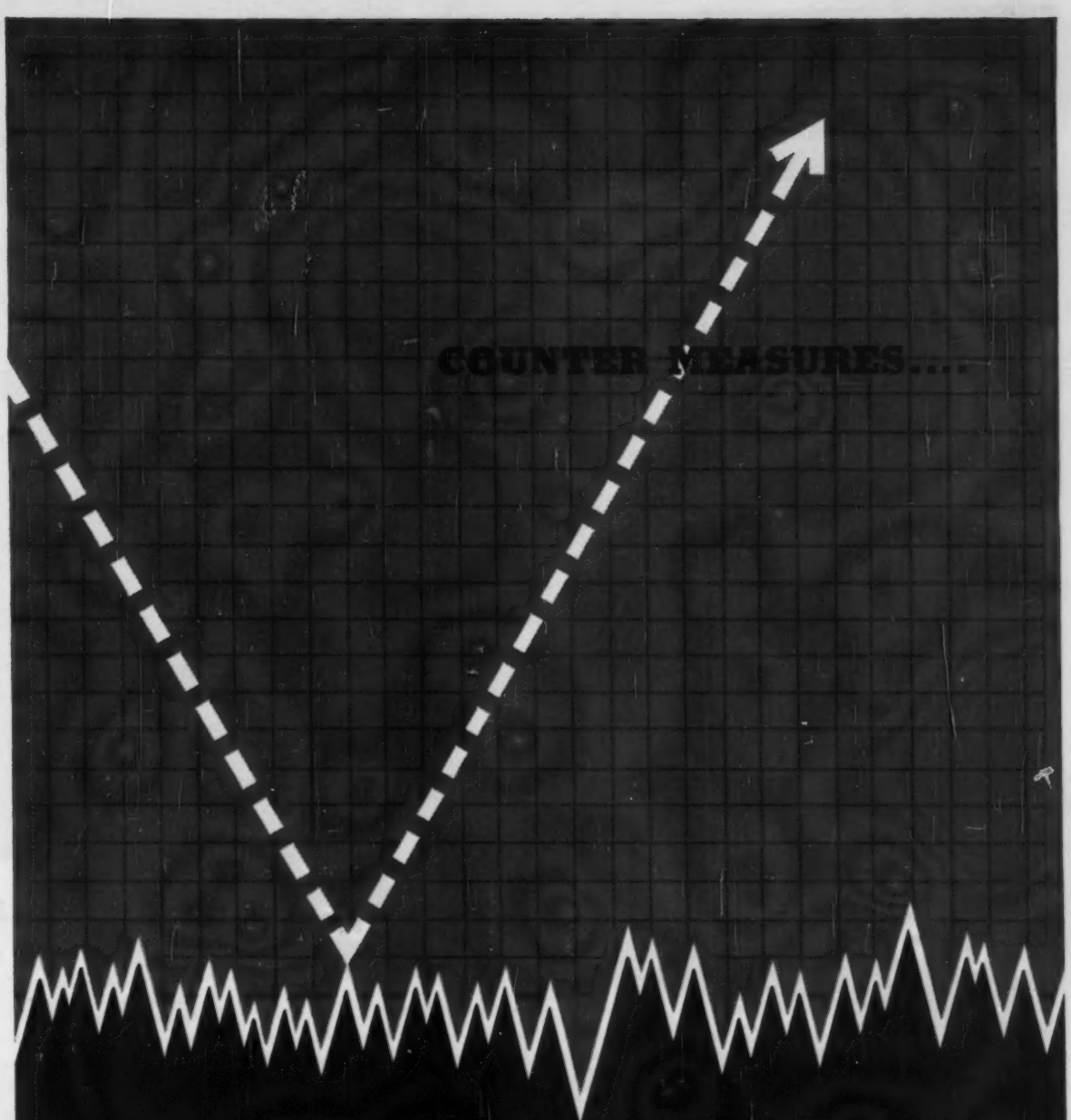
Dec. 3-5: Eastern Joint Computer Conf., AIEE, ACM, IRE, Bellevue-Stratford Hotel, Philadelphia.

Dec. 3-5: Global Communications, Second National Symposium, AIEE, PGCS of IRE, Colonial Inn-Desert Ranch, St. Petersburg, Florida.

Dec. 4-5: Vehicular Communications, Annual Meeting, PGVC of IRE, Hotel Sherman, Chicago.

Dec. 9-11: Mid-America Electronics Convention, MAECON, Municipal Auditorium, Kansas City, Mo.

Jan. 12-14: Reliability and Quality Control, Fifth National Symposium, PGRQC of IRE, AIEE, ASQC, EIA, Bellevue-Stratford Hotel, Phila.



Instruments For Industry, actively engaged in the development of countermeasure devices for the protection of units on land, on sea and in the air, is proud of its record of service to the Army, Navy, Marines and Air Force. In addition, I.F.I. has responded to demands of industry by producing a line of wide band amplifiers built to the highest specifications.

Instruments For Industry *announces the opening of an ultra modern plant located at 101 New South Road Hicksville, Long Island, New York*

Graduate engineers with two or more years of circuit application in the fields of electronics or physics are invited to meet with Mr. John Hicks in an informal interview or send complete resume to: Dir. Personnel, IFI, 101 New South Road, Hicksville, New York.

FLEXIBILITY IN THE FIELD...

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EMPIRE'S NOISE & FIELD INTENSITY METER MODEL NF-105

Model NF-105 remotely located from its antenna, for personnel safety.

- Measures 150 kilocycles to 1000 megacycles accurately and quickly with only one meter.
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- Direct substitution measurements by means of broad-band impulse calibrator, without charts, assure repeatability.
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- Safeguards personnel . . . ALL antennas can be remotely located from the instrument without affecting performance.
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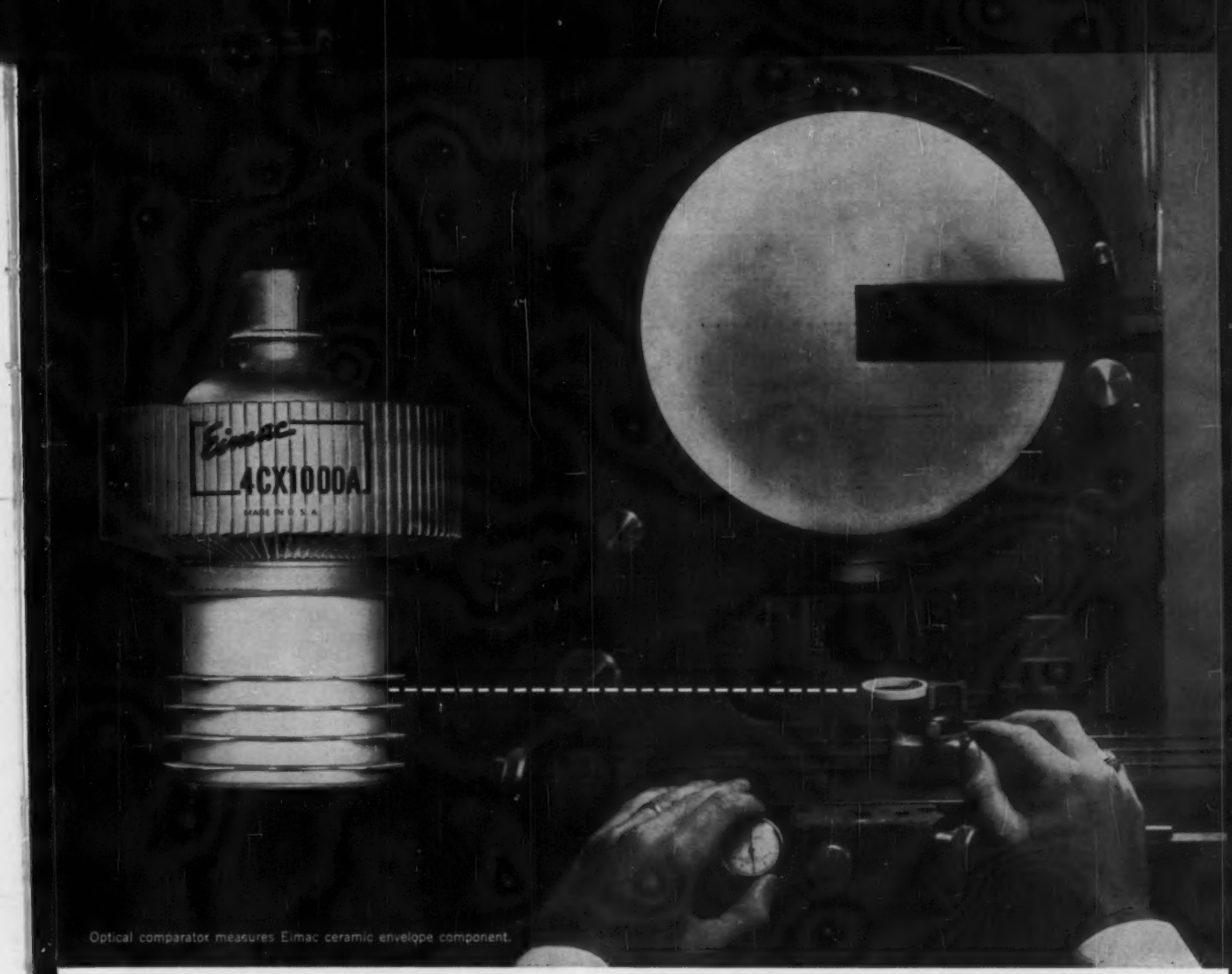

Optical comparator measures Eimac ceramic envelope component.

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Electrode spacing is critical in modern high-performance vacuum tubes. Dimensional uniformity of the material used for the vacuum envelope has a direct effect on the accuracy of this spacing. The high alumina ceramic rings used in Eimac stacked-ceramic tubes can easily be held to tolerances of ± 50 millionths of an inch at production speeds. This degree of accuracy is not possible with glass techniques in high speed production.

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Write our Application Engineering Department for a copy of the booklet "Advantages of Ceramics in Electron Tubes."

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Digital Voltmeters for Missile Check-out Systems

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Measures DC Volts, Voltage Ratio, and Ohms

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Measures DC Volts, Voltage Ratio, and Ohms

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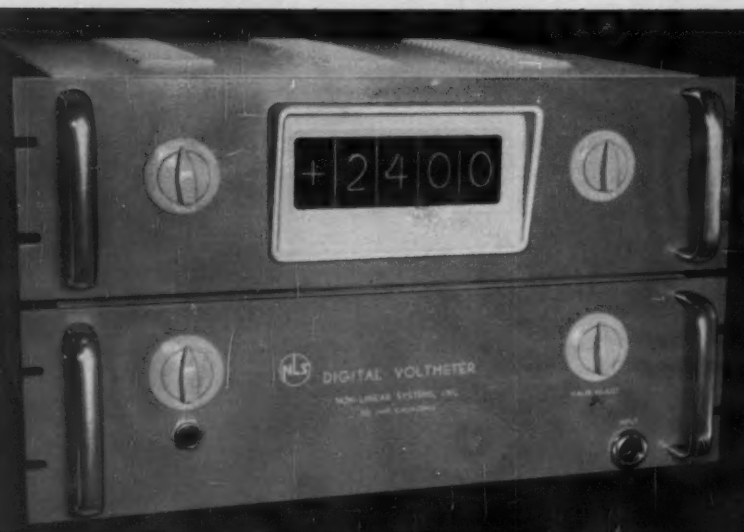
Measures DC Volts

MODEL V-25
5-DIGIT VOLTMETER
Measures DC Volts



The *first* digital voltmeters designed specifically for missile and weapons system check-out . . . the *first* compact, single-unit instruments to automatically and continuously measure and display DC voltages, voltage ratio, and resistance . . . the *first* digital voltmeters to attain the high standards of performance listed to the right! With their many exclusive features, NLS Series 20 instruments provide greater reliability and far more flexibility than have ever been offered by conventional stepping-switch meters. See these new, ultra-reliable, high-speed instruments in action! *Wire or phone collect* to arrange for an on-the-spot demonstration of the NLS Series 20 Digital Voltmeters.

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NLS manufactures the most complete line of three, four, five, and six digit instruments for automatically measuring and displaying DC and AC voltages, voltage ratio, and resistance.

ACCURACY

Scale factor and linearity accurate to 0.01%, approaching accuracy of standards laboratory equipment. 10 megohm input impedance.

RELIABILITY

Utilizes transistors and mercury-wetted relays. Provides highest degree of reliability ever attained in any digital voltmeter.

SPEED

Five times faster than conventional digital voltmeters. Displays a minimum of three measurements per second.

CONVENIENCE

Easiest to operate, easiest to read. Only NLS provides all of these features in one compact instrument: automatic range changing, automatic decimal placement, automatic polarity indication . . . exclusive snap-in readout with no-glare hood . . . plug-in component modules throughout.

VERSATILITY

Plug-in connectors allow for simple attachment of such accessories as AC/DC converter, low-level amplifiers, remote readouts, and serial converters to permit driving of automatic typewriters, flexowriters, and tape or card punching units.

Originators of the Digital Voltmeter

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We have five Technical Bulletins giving engineering data on the properties and forms of Handy & Harman Silver Alloys. We would like you to have any or all of those that particularly interest you. Your request, by number, will receive prompt attention.

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Transistorized, plug-in modules for measuring DC to 0.01%, AC to 0.1%, ohms to 0.01%, DC ratios to 0.01%, and AC ratios to 0.02%

Plus auxiliary modules for building complete automatic digital systems

Typical digital, missile electrical checkout system using the new E-I modular design. All E-I modules are designed to fit standard 19" racks.

Now build precision digital voltmeters, digital ohmmeters, digital ratiometers, or complete digital, missile electrical checkout systems from standard, off-the-shelf modules.

DC DIGITAL VOLTMETERS

Specifications	Model DVA-400	Model DVA-500
Display	4 digits, polarity, decimal point	5 digits, polarity, decimal point
Range	.0001-999.9 volts	0.0001-999.99 volts
Accuracy	±1 digit	±(0.01% and 1 digit)
Automatic Features	Polarity, ranging	Polarity, ranging
Controls	Digits gain, manual and automatic ranging, power on-off-standby	Digits gain, manual and automatic ranging, power on-off-standby

Write for Bulletins 180.1 and 180.2

AC-DC DIGITAL VOLTMETERS

Specifications	Model DVA-410	Model DVA-510
DC	Same as DVA-400	Same as DVA-500
AC		
Accuracy	0.1% or 2 digits	0.1% or 2 digits
Frequency Response	30-10,000 cycles	30-10,000 cycles
Range	.0001-999.9 volts	0.0001-999.99 volts
Controls	Same as DVA-400, AC-DC	Same as DVA-500, AC-DC

Write for Bulletins 180.1, 180.2, 180.4

Modules never become obsolete—As needs change simply regroup present modules or add new ones. Your system is always up-to-date at minimum cost and engineering. Internal construction is also modularized for maintenance ease.

Fully transistorized circuitry—All transistor circuits on encapsulated plug-in cards

- gives increased reliability
- reduces power consumption
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- permits miniaturized packages
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Many new advanced application features and specifications—The result of thousands of applications and field experience from more than 2,500 digital instruments and systems.

- Now you can "read through" superimposed ripple on DC—and know its magnitude—by using the calibrated digits gain control located on the front panel. Steps by 1, 2, 3, 4, 5, 10, 50 and 100 digits.
- Controlled ranging by switch position—"automatic," "hold," "manual"—enables operator to manually control range position but still select automatic ranging in the same instrument.
- Power control for "on," "off," and "stand by" positions.
- Wider dynamic range covering all voltages from 100 microvolts to 1,000 volts, resistance range from 10 milliohms to 10 megohms—in single instruments.
- Input power frequencies from 50 to 400 cycles.
- New balance logic for faster down ranging.
- Automatic AC ranging from 30 to 10,000 cycles.
- Controlled stepping switch drive increases switch life by a factor of five—proved by actual tests.
- Meets many MIL specifications.

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1. Universal 3½" x 19" x 12" chassis with mounting hardware for any rack.
2. Digital outputs may also drive storage matrices, go-no go comparators, and other auxiliary modules.
3. All contacts readily accessible at rear panel on connectors.
4. With auxiliary plug-in modules, digitized data is provided in printed form, punched cards or tape with no modification to basic measuring instruments.

DIGITAL OHMMETERS

Specifications	Model DOA-400	Model DOA-500
Display	4 digits	5 digits
Range	00.01 ohms to 10 megohms	000.01 ohms to 10 megohms
Automatic Features	Ranging	Ranging
Controls	Digits gain, manual and automatic ranging, power on-off-standby	Digits gain, manual and automatic ranging, power on-off-standby

For accuracy specifications see Bulletin 180.3

Write for Bulletins 180.1, 180.3

AC RATIOMETERS

Specifications	Model DRA-490	Model DRA-490
Display	5 digits	5 digits
Ratio Range	0.0000-1.0999	0.0000-1.0999
Accuracy*	±2 digits	±2 digits
Controls	Digits gain, power on-off-standby	Digits gain, power on-off-standby, reference selector
External Reference	1 volt rms	Choice of 3

*Calibration at 400 cycles; 60 cycle models also available.

Write for Bulletin 180.9

DC RATIOMETERS

Specifications	Model DRC-400	Model DRC-500	Model DVC-400†
Display	4 digits	5 digits	4 digits, polarity
Ratio Range*	.0000-.9999	.00000-.99999	00.01-99.99 volts
Accuracy	±1 digit	±(0.01% and 1 digit)	±1 digit
Controls	Digits gain, power on-off-standby	Digits gain, power on-off-standby	Digits gain, power on-off-standby
External Reference**	1 to 10 volts	10 to 100 volts	±100 volts

*Models DRA-400L and DRA-500L, 10% overscale read out. For higher ratio ranges, see Bulletin 180.7.

†Recommended for computer applications.

**Internal reference supply optional; specify DRA in place of DRC.

Write for Bulletins 180.1 and 180.7

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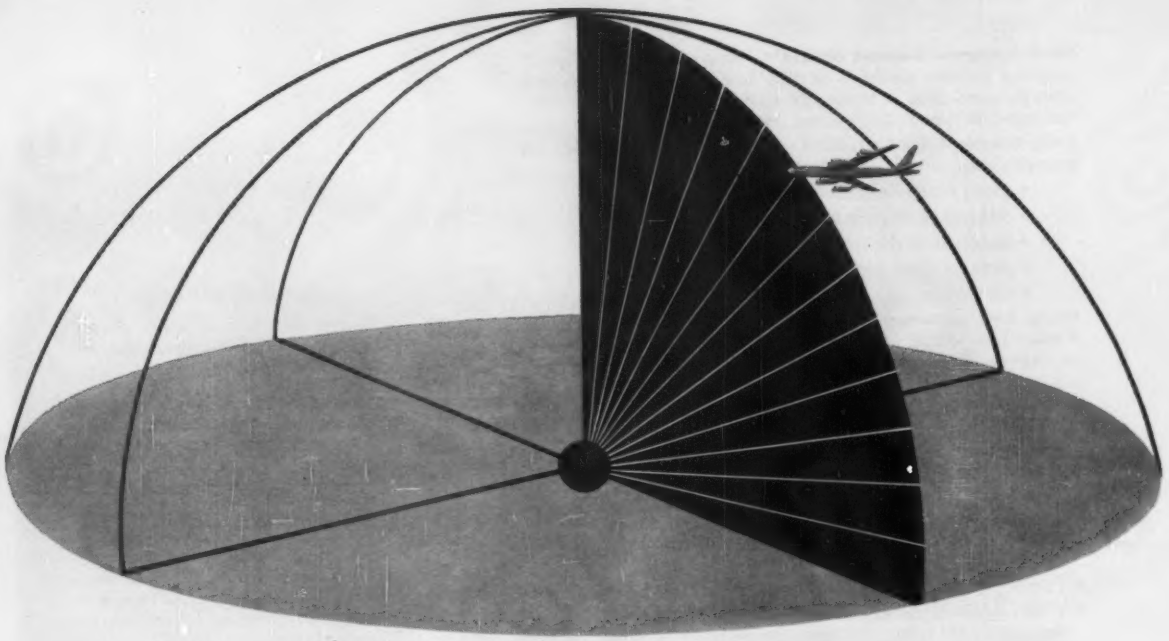


DEFEND

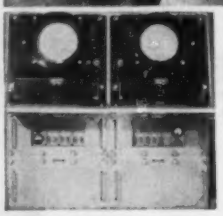
Today, creative engineering at Hughes is on the move to DEFEND . . . to counter the threat of aggressive action with electronic speed and precision.

Hughes in Fullerton, California is now creating these systems for total defense:

ELECTRONIC SCANNING RADARS, with beams that provide three-dimensional protection.

DATE PROCESSORS, which monitor the action of hundreds of aircraft and store the shifting tactical situations for high-speed assignment of defense weapons.

ELECTRONIC DISPLAY SYSTEMS which present tactical information in symbolic or language form.



Also under development are new three-dimensional radar systems for installation on surface and subsurface naval vessels. Study programs have been initiated in radar, computers, displays and integrated defense systems.

To further these studies, creative engineers and physicists are now needed. These positions promise unusual reward and opportunity for growth. Inquire further . . . for information write to Mr. L. H. Wike at the address at right.

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It is now looking for the right person to head the existing development laboratory.
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It would be desirable if you were familiar with present applications and future potentialities of transistors and diodes, in order to contribute actively to the general policy of the new firm.
Salary will be commensurate with experience and ability. Transportation and moving expenses will be paid.
Written replies will be sent to all applicants.
Chosen candidates will be invited for a personal interview in New York City, expenses paid.
Please write, enclosing detailed resume, to Project T.D.L., Olivetti, Ivrea, Italy.

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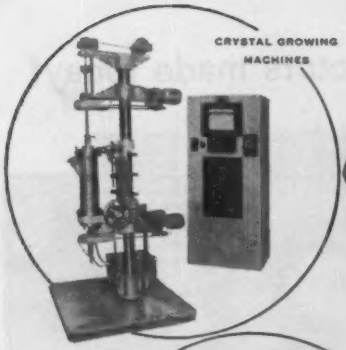

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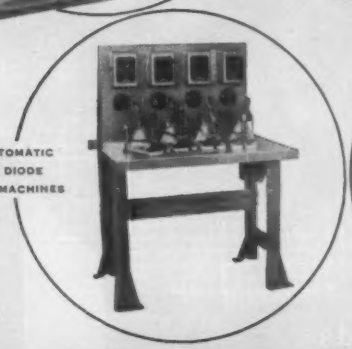

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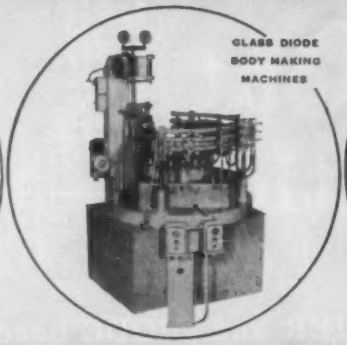

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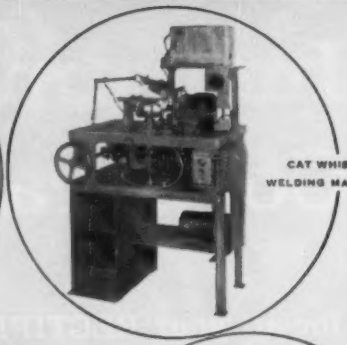

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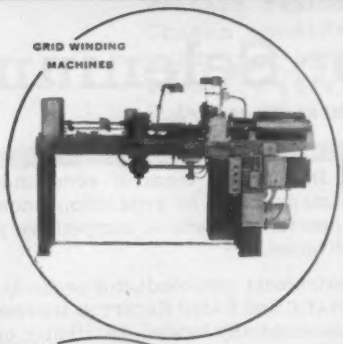

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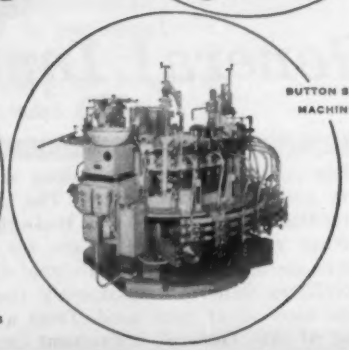
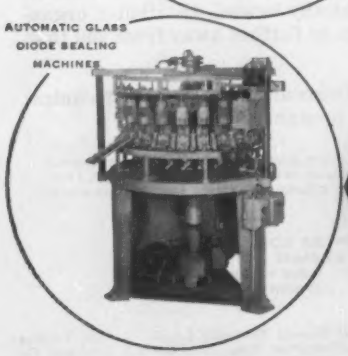


BUTTON STEM MACHINES



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FOR MOISTURE AND DUST PROBLEMS

Moisture-seal miniature potentiometers are supplied for use where hermetic sealing is not justified. These Circuit Type MS units combine a leak-proof metal case and an "O" ring shaft seal for maximum protection. Resistance values cover from 125 to 350,000 ohms, in 2 and 3 watt power ratings. Case diameter available in ¾" and 1".

For applications requiring a vapor-tight seal, Circuit provides Hermetically Sealed Potentiometers. These are evacuated to 30" of mercury vacuum and filled with dry nitrogen. Cases are of half-hard brass in ¾" and 1" diameter sizes.

FOR HIGH TEMPERATURE REQUIREMENTS

All standard Circuit potentiometers, except sub-miniature models, are available with modified construction designed for operation in ambient temperatures up to 150°C. All electrical connections are "hard" soldered and case insulation is rated for continuous operation in excess of 150°C. These Type HT units are rated for full power operation at 100°C., and are de-rated linearly to zero power at 150°C.

A limited quantity of advance copies of a new Circuit Precision Potentiometer Catalog is available. Write for yours soon.

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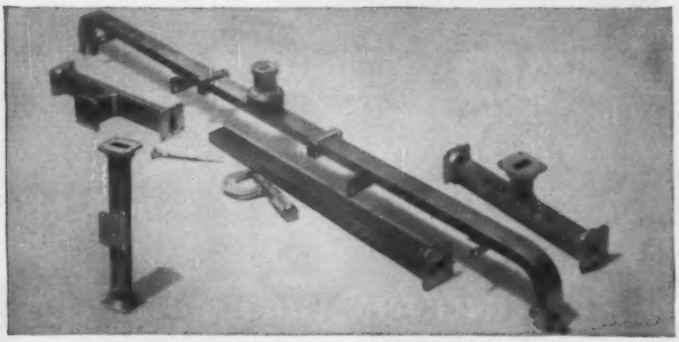
Nickelonic News

DEVELOPMENTS IN NICKEL AND NICKEL ALLOYS AND THEIR APPLICATIONS

First commercial atomic clock . . . waveguides of low permeability Monel "403" hold down signal distortion



No problem fabricating these waveguides of Monel "403" low permeability alloy, reports National. The intricate tubes carry microwaves in the Atomichron atom-regulated frequency standard.

Heart of the "clock" — a cesium beam tube — Monel "403" alloy provides the tube's pole assemblies with excellent mechanical properties plus low magnetic permeability. Manufactured by National Company, Inc., 61 Sherman Street, Malden 48, Mass.

. . . clock generates frequencies accurate to 5 parts in 10 billion!

MALDEN, MASS.: You can now tell time accurately down to 100 millionths of a second with the Atomichron†, first commercial atom-regulated "clock."

How it works

Waveguides feed a tuned microwave signal through a stream of cesium atoms. As signal reaches the atoms' resonant frequency, it changes some atoms in internal structure. This change is sensed by a detector and signalled to a servo system, which regulates the frequency of a basic oscillator at precisely the atomic resonance value. By means of electronic multipliers and dividers, this oscillator produces standard output frequencies of 0.1, 1.0, 5, 10, and 100 megacycles — the required "clocking" action.

Designers chose Monel "403"* low permeability nickel-copper alloy for the waveguides, radio frequency sections and magnet pole assemblies, because it provides magnetic permeability so low that atomic resonance remains free from distortion. Monel "403" alloy offers excellent vacuum and mechanical properties, is readily machined and formed into intricate shapes.

Like all Inco Nickel Alloys, Monel "403" alloy is freely available.

Pertinent Literature: Write for "Basic Data-Monel '403' Low Permeability Nickel-Copper Alloy."

†T. M. of The National Company, Inc.

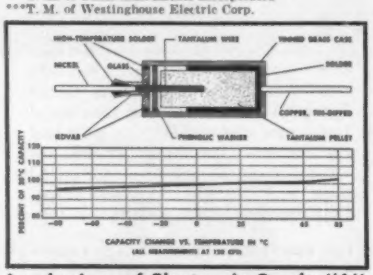
Nickel leads, welded directly to tantalum, boost capacitor ruggedness

DALLAS, TEX.: For maximum reliability, new Texas Instruments *tan*-TI-*cap*** capacitors depend on leads of Electronic Grade "A"* Nickel. This strong, tough nickel wire, welded soundly and easily to the tantalum stubs, helps provide the good connections needed to withstand mechanical and thermal shock.

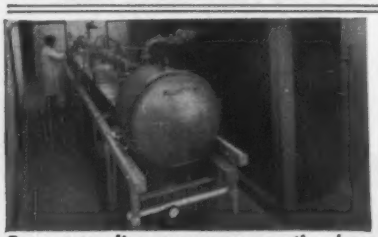
Electronic Grade "A" Nickel is highly resistant to oxidation and corrosion. What's more, it provides tight hermetic seals (note figure at right) and speeds unit installation. Another Nickel-containing alloy, Kovar***, is also used to assure tight metal-to-glass seals.

Pertinent Literature: Write for Inco Technical Bulletin T-15.

**T. M. of Texas Instruments Incorporated
***T. M. of Westinghouse Electric Corp.



Lead wires of Electronic Grade "A" Nickel strengthen this new *tan*-TI-*cap* Solid Tantalum Electrolytic Capacitor.



For outstanding vacuum properties, key parts of the Mark 1-T4 accelerator are made of Electronic Grade "A" Nickel. Built by Applied Radiation Corp., Walnut Creek, Cal.

Nickel materials keep electrons "in line" in new linear accelerator

WALNUT CREEK, CALIF.: Intense electron, neutron and X-ray beams are generated by this new ARCO linear electron accelerator. In order to operate at very high vacuums—10^{-7} to 10^{-8} mm Hg—its vacuum envelope must be degassed by baking out at 400°C. ARCO designers specify Electronic Grade "A" Nickel for the envelope because it provides the excellent vacuum properties required. This metal also resists oxidation, corrosion and retains its strength at operating temperatures well above 400°C.

Nickel plating improves seals

All metal surfaces of the envelope's metal-ceramic seals are plated with Inco Nickel. Inco Nickel is easily brazed, protects parts from oxidation. Its purity facilitates the elimination of all organic products from the vacuum envelope, permitting excellent radio-frequency operation.

Pertinent Literature: Write for "Inco Nickel Alloys for Electronic Uses."

*Registered trademark, The International Nickel Company, Inc.

INCO TRADE MARK **THE INTERNATIONAL NICKEL COMPANY, INC. • 67 Wall Street • New York 5, N. Y.** INCO TRADE MARK

Electron Tube News
—from SYLVANIA

Anticipating the circuit designer's needs—everywhere in electronics

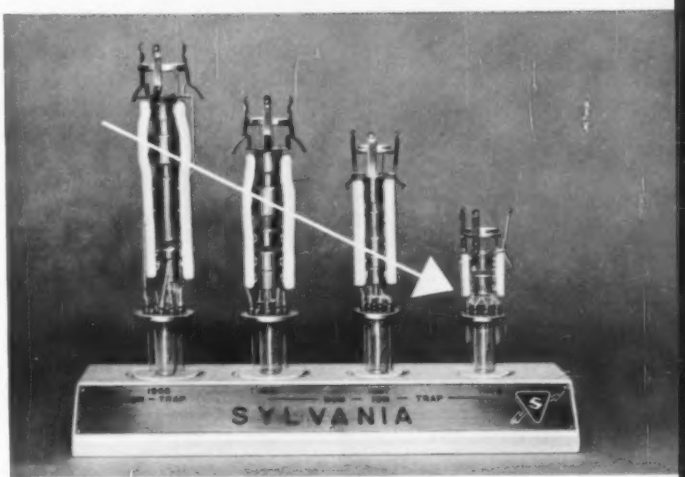
TELEVISION . . .

New Tripotential Electron gun takes another 2-inch slice off picture tube length

Sylvania, pioneer in 110° picture tube development, introduces another basic design innovation in cathode ray tubes—the short tripotential focus electron gun. It reduces picture tube length up to 2 1/8 inches, yet permits use of standard design centering magnets, yokes and other associated components.

Voltages required to operate tripotential focus picture tubes are available in ordinary TV receiver circuit designs.

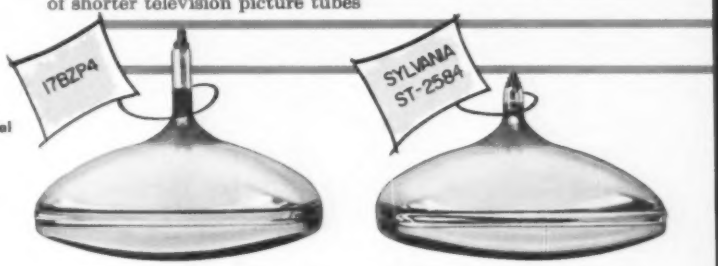
The new gun is much less complicated than conventional types. Its simplicity of design not only makes the gun inherently more rugged but allows for greater uniformity in manufacturing and assembling. This means less arcing, fewer shorts and better over-all performance throughout life.

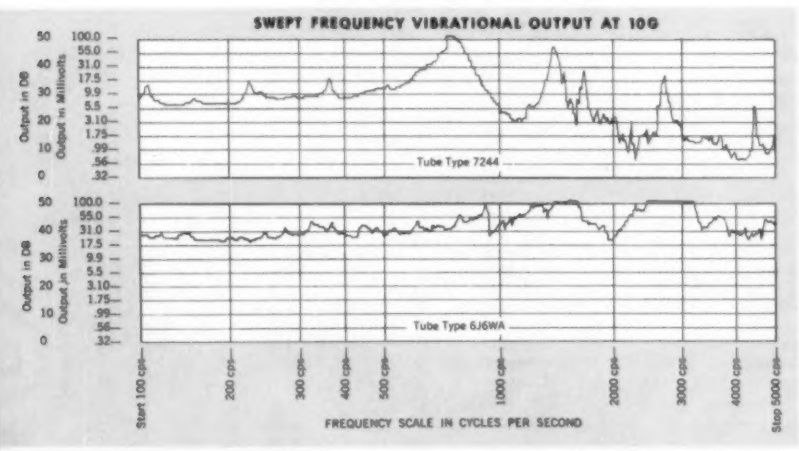


Tripotential Electron gun is a major advance in the evolution of shorter television picture tubes

Mechanical Dimensions Comparison Chart
Over-all Dimensions (Inches)

Screen 110° types, 1 1/8" neck dia.	Conventional Tubes	Sylvania Tripotential
17"	12 9/16	10 7/16
21"	14 11/16	12 9/16
24"	15 7/8	13 3/4





Over a frequency range of 100 to 5,000 cps at a 10 G level the type 7244 produced a vibrational output in the range of 6 millivolts average while the 6J6WA averaged 60 mv or higher

RELIABILITY . . .

Stacked tubes in glass set new standards for reliability in shock and vibration tests

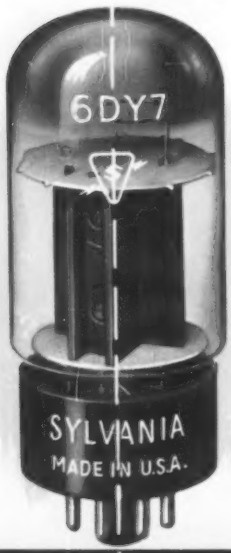
Production of Sylvania's new stacked tubes in glass, types 7244 and 7245, is being stepped up to meet the increasing demands of military and industrial customers. Fast growing acceptance is based on the inherent reliability of the stacked mount structure:

Reliability

Actual vibrational test data of the stacked structure compared with a conventional tube indicates as much as 2 to 1 improvement in vibrational output at 6 times the G level.

AUDIO . . .

New dual-pentode for STEREO

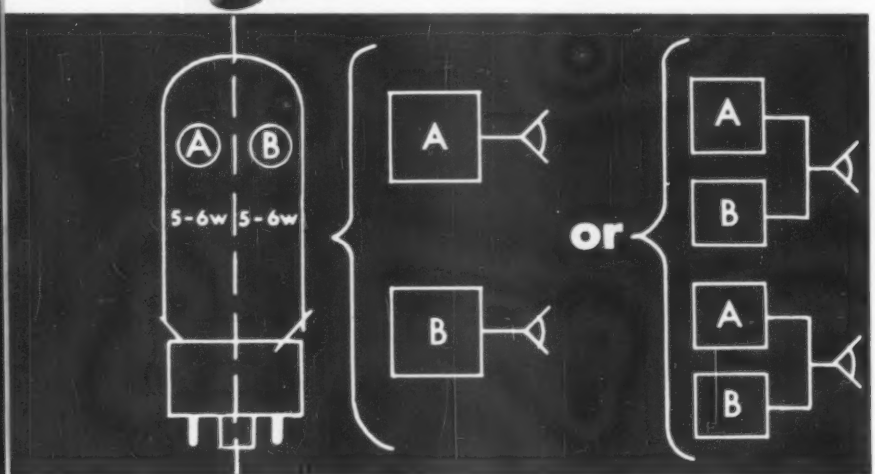


Sylvania Framelok construction is adapted for greater circuit flexibility, better performance and new economy

A new tube design which takes advantage of the symmetry of the Sylvania Framelok tube construction is being developed specifically for application for the output stages of stereophonic sound circuits. Because it incorporates two identical pentodes in one envelope this new Framelok tube provides design flexibility and can introduce substantial circuit economies.

This new design concept now makes possible the use of a single Framelok tube—common cathode and screen grid—that will supply 5 to 6 watts usable audio output in each channel. Its unusual flexibility also permits application in push-pull in each stereo channel or two tubes push-pull, parallel in high power monaural systems.

In addition to its potential cost advantages there are the many benefits inherent only in the Framelok design: • Greater uniformity of electrical characteristics in tube after tube • Greater stability of electrical characteristics during tube life • Less change in electrical characteristics due to element temperatures at high dissipation levels • Better control of cutoff • Less chance for shorts, microphonism and noise • Better plate-to-screen current ratios • Less arcing.



New Framelok dual pentode type designed for stereo can supply 5 to 6 watts audio output single ended at the voice coil for each channel. High flexibility allows one tube to provide push-pull operation for each channel

RELIABILITY (Continued)

	Type 7244	Type 6J6WA
Frequency	40 cps	25 cps
G Level	15 G's	2.5 G's
Vibrational Output	15 MV	25 MV

Stability and Uniformity

The planar structure of the stacked tube in which all elements are arranged in parallel planes insures optimum stability of operation and uniformity of characteristics.

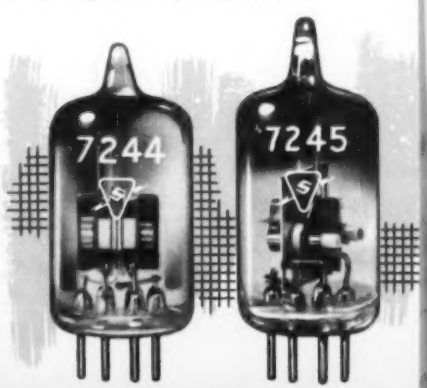
Fewer dimensions need to be controlled, providing a major simplification and reduction in the number of critical tolerances in parts fabrication.

Increased Mechanical Life

The ceramic mount structure is solidly integrated and relative motion between elements is negligible. The entire mount is displaced with shock and vibration as one solid entity, and parts or elements will not react independently. In fact, ceramic stacked mount tubes in glass have survived several hundreds of hours on 15 G, 40 cycle vibration fatigue with no significant change—a test which usually destroys conventional tube types in less than a hundred hours.

Lower Costs for Customers

The stacked tube in glass means less equipment maintenance. In-plant tube selection can be eliminated or reduced. Missile flights and other military operations have a higher probability of success with the rugged stacked tube. No major circuit redesign is necessary since the types are basically retrofits. The 7244 and 7245 can go in present equipment where 6J6WA and 6J4WA types are used with only slight compensations.



AUDIO

Beam power audio pentode for quality amplifiers

Better power output and less distortion than comparable types are the chief attributes of the new 6BQ5. It maintains initial peak performance standards throughout life. Throughout life tests the tube exhibits no "slumping" due to excessive screen dissipation. It delivers 5.6 watts at 9.2 percent distortion single ended under 4.30 v. signal input and 5.95 watts with a 4.70 v. signal. In push-pull at 250 v. plate & screen, the 6BQ5 delivers 10. 65 w. at 3.4 percent distortion; at 300 v. plate & screen, 16.5 w. at 4.16 percent distortion.

Improved high-mu twin triode serves as audio amplifier or phase inverter

As a result of Sylvania's continuing tube improvement program, a superior 12AX7 is now available with sharply reduced hum and noise. Through improved aging and processing schedules Sylvania engineers have been able to maintain the output advantages of the tube while at the same time minimizing the hum and noise characteristics.

Designed primarily for quality audio circuits, the improved 12AX7 has a center tapped heater for operation at 12.6 or 6.3 volts. It has separate cathodes and is packaged in a T-6½ envelope.

New double triode for extremely critical audio applications

Wherever extreme limits on hum and noise must be met, Sylvania's new 7025 will fill the requirements. Its special design incorporates a folded coil heater that improves over-all performance. The new high mu twin triode has an equivalent noise and hum voltage of 1.8 microvolts rms average and 7 microvolts rms maximum.

Low hum-low noise triode-pentode for hi-fi

Sylvania's new 7199 is a 9-pin miniature medium mu triode and sharp cutoff pentode designed particularly for high-quality audio applications. The triode is normally used as a phase inverter, although many other possibilities exist, while the pentode is used as a high-gain audio amplifier.

Folded coil heaters, separate cathodes and an internal shield to reduce electrical coupling combine to provide a pre-amplifier tube with low noise, low micro and high reliability, as required in high-performance audio systems.

New rectifier for hi-fi audio equipment

Double anode, indirectly heated, common cathode rectifier type 6CA4 is now available from Sylvania. The new tube can handle two 6BQ5 output tubes. It delivers 150 ma. maximum DC output current.

RATINGS (Design Center Values)

Peak inverse plate voltage			1000	volts max.
D. C. output current			150	ma. max.
Peak plate current per plate			450	ma. max.
Peak voltage between cathode and heater (cathode positive with respect to heater)			500	volts max.
Transformer voltage	2x250	2x300	2x350	volts, rms.
Total effective plate supply resistance per plate	150	200	240	ohms min.

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MOBILE COMMUNICATIONS...

Sylvania introduces four new receiving tubes designed to meet the specialized requirement of mobile radio equipment

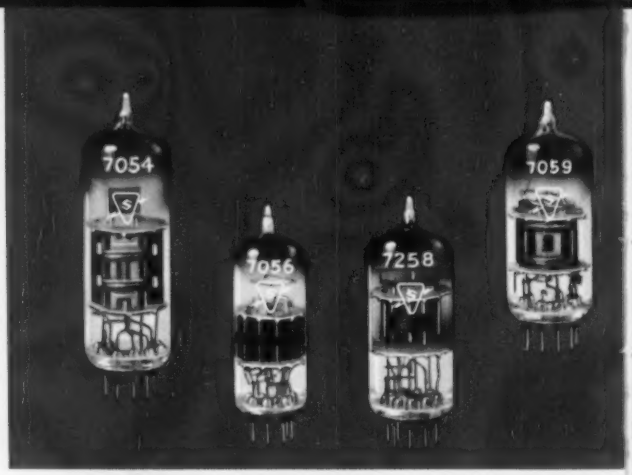
Now manufacturers of commercial and industrial mobile transceivers can select from a new line of rugged Sylvania receiving tubes designed with the special conditions of mobile radio in mind. The new tubes, types 7054, 7056, 7059 and Sylvania original type 7258, operate from B supply voltages ranging from 100 to 250 volts. The heater voltages of the line are centered at 13.5 volts—the midpoint of heater voltage range for vehicular equipments. This allows a full 3.52 volt safety margin for the tubes to take care of the fluctuating power supply that may occur in such mobile equipment.

In the Sylvania original type 7258, the pentode section may be used as an RF or IF tube. The triode section can serve as a low frequency oscillator or general purpose amplifier.

Type 7054—a 9 pin sharp cutoff pentode
Type 7056—a 7 pin sharp cutoff pentode
Type 7059—a 9 pin medium mu triode, sharp cutoff pentode
Type 7258—a 9 pin medium mu triode, sharp cutoff pentode

Characteristics and typical operation for Sylvania original type 7258

	Triode Section	Pentode Section
Plate Voltage	150	125 Volts
Grid No. 2 Voltage		125 Volts
Grid No. 1 Voltage	−3	0 Volts
Cathode Bias Resistor		56 Ohms
Plate Current	15	12 Ma
Grid No. 2 Current		3.8 Ma
Transconductance	4500	7500 umhos
Amplification Factor	21	
Plate Resistance (Approx.)	4700	170,000 Ohms
Grid No. 1 Voltage for Ib=20 ua (approx.)	−17	−6 Volts
Plate Current at Ec1 = −3 V Rk = 0		1.6 Ma



INDUSTRIAL & MILITARY C-R TUBES

Sylvania introduces a brand-new special purpose 12" CRT designed particularly for radar and medical applications

Now, an economical 12" 'scope tube, type SC2558, with fast response time, high impedance input and post deflection acceleration is available from Sylvania. The new tube, which will sell for approximately ½ as much as comparable types, incorporates both electrostatic deflection and focus. Its lower operating voltage eliminates the need for an elaborate power supply. With post deflection acceleration, greater deflection sensitivity is possible with increased brightness.

The large screen size of type SC2558 is especially convenient for group viewing of medical and radar displays. The new tube incorporates an aluminized screen, standard base and is available in any phosphor coating specified.

Typical Operating Conditions

Anode No. 3 Voltage	10,000 Volts D.C.
Anode No. 2 Voltage	5,000 Volts D.C.
Deflection factor	
Deflecting Plates 1-2	105 to 145 v/in.
Deflecting Plates 3-4	80 to 115 v/in.

SYLVANIA

Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
P. O. Box 1190, Station "O," Montreal 9.

LIGHTING · TELEVISION · RADIO · ELECTRONICS · PHOTOGRAPHY · ATOMIC ENERGY · CHEMISTRY-METALLURGY

Please send additional information on the items checked below:

+ ☐ New tripotential gun

+ **Stacked tubes in glass:**
+ ☐ Type 7244
+ ☐ Type 7245

+ **Industrial & Military**
+ **Cathode Ray Tubes:**
+ ☐ Type SC2558

Audio Tubes:
- ☐ New Framelok tube for stereo
- ☐ Type 6BQ5
- ☐ Type 12AX7
- ☐ Type 7025
- ☐ Type 6CA4
- ☐ Type 7199

Mobile Radio Tubes:
- ☐ Type 7054
- ☐ Type 7056
- ☐ Type 7059
- ☐ Type 7258

Name_____

Address_____

Company_____

Use this handy business reply card to request additional information on these important new Sylvania developments

Leesona No. 108 Coil Winders wind transformer coils for the Sorensen Model MR36-30 Magnetic Ranger, a wide range regulated DC power supply, delivering 5-36 VDC at 0-30 amps, designed and manufactured by Sorensen & Co., Inc., South Norwalk, Connecticut.

High Accuracy...

that's why SORENSEN & CO. chose Leesona® No. 108 Coil Winders

Sorensen & Co., Inc. — leader in the field of regulated power supplies — designed the Sorensen Magnetic Ranger used in missile and aircraft test systems — *and it chose Leesona 108's to wind the transformer coils.*

At Sorensen, where accuracy, speed, and economical operation are always critical factors, this was not a radical decision. Leesona machines have been winding Sorensen's transformer coils for years — and doing a superior job all along.

Leesona No. 108 is a precision machine with controls that can be adjusted to *your* coil winding problems. Quick set-up, easy operation. Accommodates wire sizes from No. 20 to No. 42 and finer, winds up to 30 coils at a time. Reversing clutch increases accuracy, decreases wear.

Many More Special Features

Find out the facts and figures showing exactly how *you* can heighten your coil winding accuracy while cutting winding costs with a flexible Leesona No. 108 Hand Feed Coil Winder. Write for details on this and other coil winding machines.

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Name.....*Title*.....

Company.....

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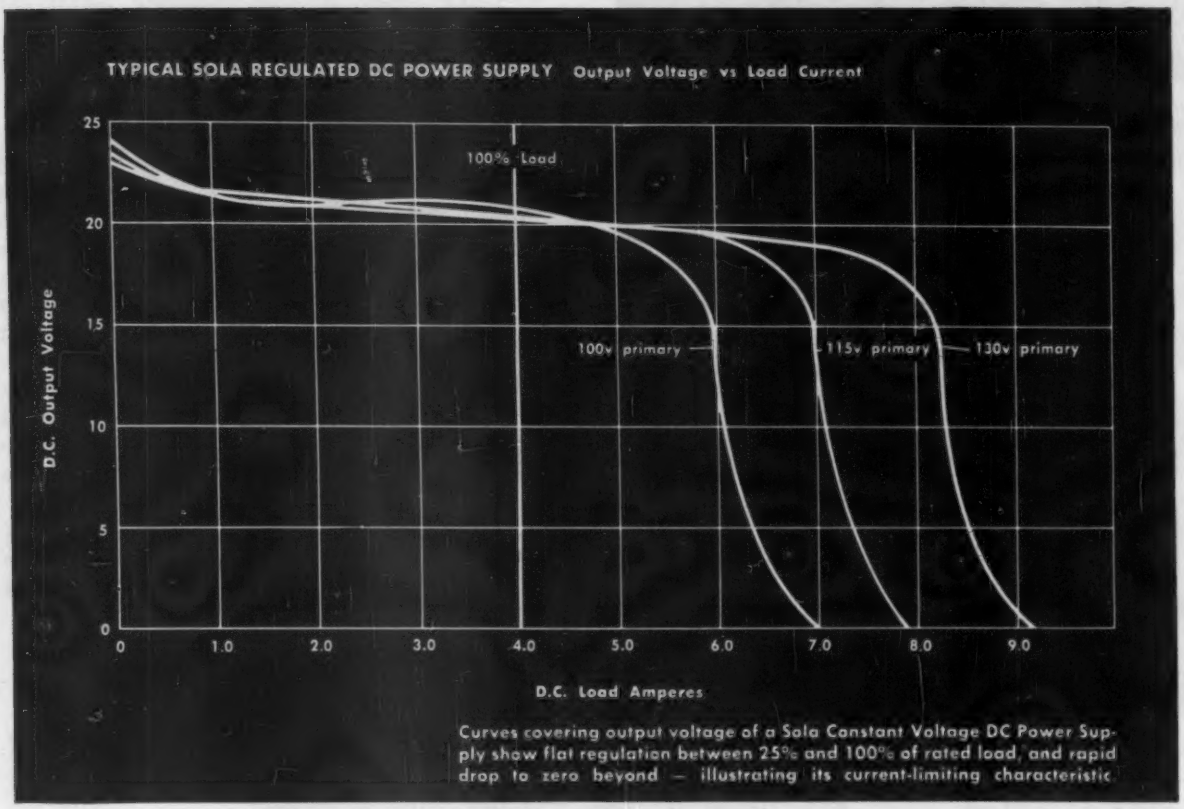


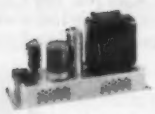
RELIABLE, regulated DC power supply

Here's a regulated dc power supply that will protect its load and itself from a fault or short beyond the primary of its power transformer. If you're interested in a simple, reliable source of regulated dc power, you'll like the Sola Constant Voltage DC Power Supply.

This very desirable load protection characteristic results from the current-limiting action of the Sola Constant Voltage Transformer. It is combined with a semiconductor rectifier, and a high-capacitance filter. The current-limiting action protects both the rectifier and capacitors from damage by preventing excessive charging current.

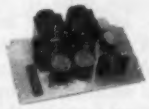
This unique combination of components results in a power supply that is unusual in other ways as well. Regulation is within ±1% with up to 10% line voltage variation . . . ripple within 1% rms . . . efficiency is high. It's also well-suited for intermittent, variable, and pulse loads.

The Sola dc supply is reliable, simple, compact, and moderately-priced.



Fixed output — six ratings available from stock

Adjustable output — six ratings from stock



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NEW HERMETICALLY-SEALED HIPERMAG CORE

PERMITS ENCAPSULATING, IMPREGNATING, OTHER PROCESSING . . . WITH NO CHANGE IN MAGNETIC VALUES

Newest development in cores for magnetic amplifier applications is the Westinghouse Polyclad hermetically sealed Hipermag core.* Polyclad insulation is applied over a new specially designed aluminum box housing the core. This hermetically seals the core and allows encapsulating, casting or impregnating—without altering magnetic properties . . . Eliminates magnetic amplifier rejects caused by changed magnetic values.

Tested for all environmental conditions, Polyclad insulation is suitable for high temperatures, protects against humidity and high-voltage stress, provides high insulation strength, with breakdown values up to 3000 volts.

Polyclad coating eliminates the need for core taping; makes possible reduced insulation cost. Rounded corners prevent shorting wire to core, allow winding directly on the core.

These cores are supplied in special sizes or in standard AIEE sizes, in one-, two-, or four-mil oriented nickel-iron alloy Hipernik® V and in one- or two-mil 4-79 Permalloy. Complete listing in Westinghouse publication 44-720.

Hermetically sealed Hipermag cores are available in production lots with normal delivery. All Hipermag cores are tested — by Roberts constant-current, flux reset technique, or to your specifications.

For more information about Polyclad hermetically sealed Hipermag cores and other Hipersil® or Hipermag cores, call your Westinghouse representative . . . or write Westinghouse Electric Corporation, P.O. Box 231, Greenville, Pennsylvania.

*Patent applied for

J-70892

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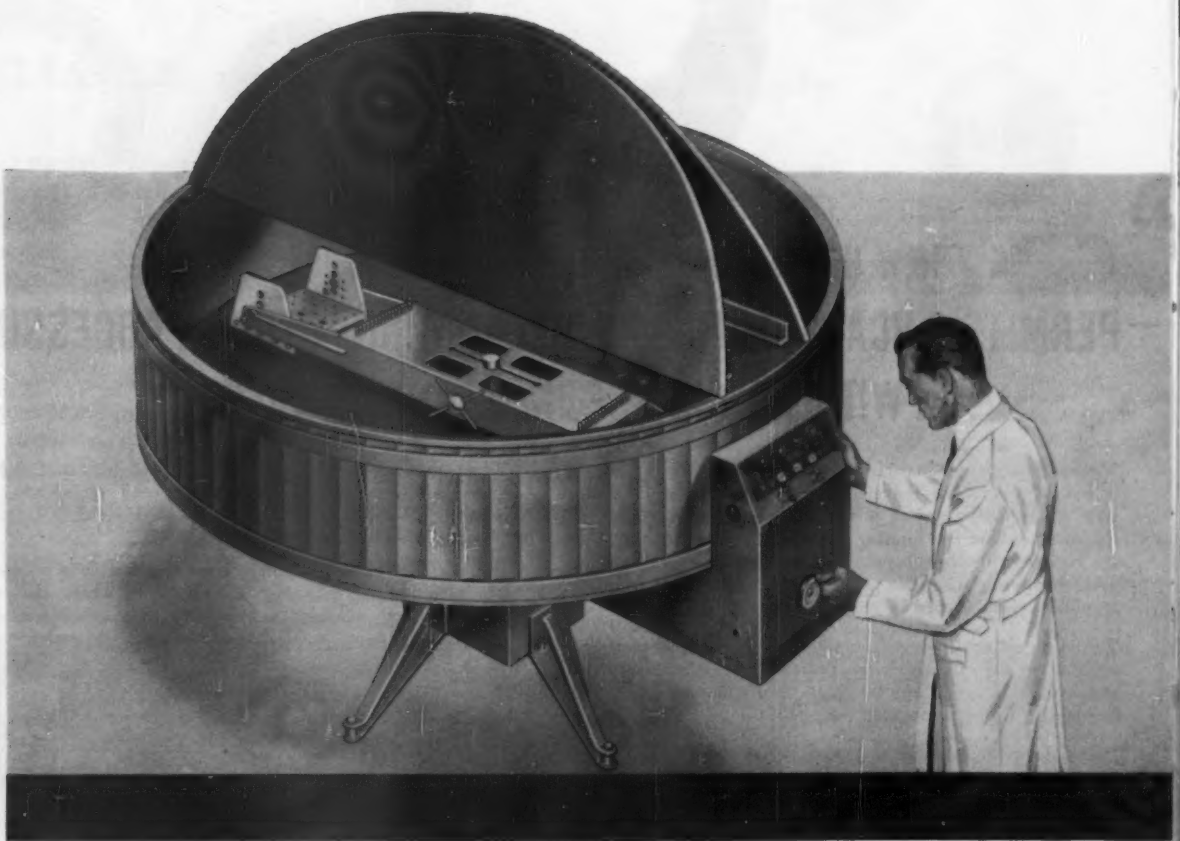
GENISCO CENTRIFUGES

with 10 times greater accuracy, larger centrifugal capacities, maximum flexibility...*and priced lower than any other centrifuges now available!*



The low-cost answer to fast, accurate testing of components under simulated operational g-forces as required by MIL-E-5272A.

These new precision centrifuges feature a unique, high-torque ball-disc integrator drive system which provides accuracies you would expect only from a rate-of-turn table. Constancy of boom rotation, including wow and long-term drift, is better than .05% at any speed setting—approximately 10 times more accurate than currently available machines. Boom speed is infinitely variable and is measured by an electronic counter built into the console.

The building block design concept gives the new centrifuges exceptional flexibility. Machines are assembled from six basic off-the-shelf components; drive system, drive motor, boom, test compartment, console and accessories. You simply select components which provide features needed to meet your specific requirements. Interchangeability of the components permits easy modification as requirements change. Kits are available for modification by the customer.

This new design concept also results in manufacturing economies which are reflected in the cost of the machines. *The new machines are the lowest priced centrifuges now available—in spite of their greater accuracy, flexibility and capacity.* Ask your Genisco representative for complete information today.

There are more than 400 Genisco centrifuges now in operation.

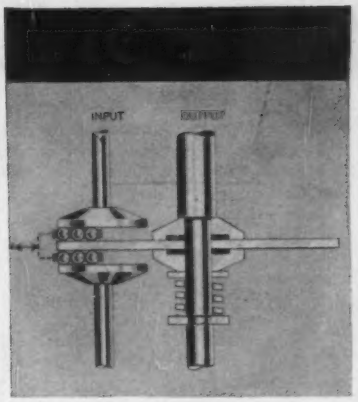
Genisco
INCORPORATED

2233 Federal Avenue, Los Angeles 64, California

brief performance specifications

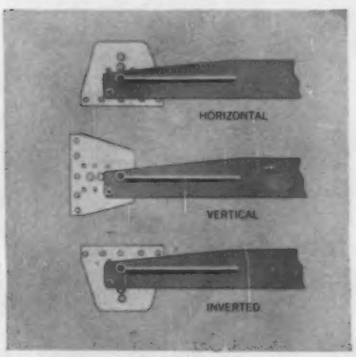
Model No.	Diameter	Test Object Weight	Capacity G-pounds	RPM Max.	G-Range Max.	Test Object Dimensions
A-1010	30" table	50 lbs. dead weight	2,500	800	.1 to 200 g's	
A-1020	60" arm	100 lb. dead weight	10,000	600	.1 to 250 g's	12" cube
A-1030	90" arm	100 lb. dead weight	10,000	400	.1 to 175 g's	18" cube

Large custom centrifuges: Genisco centrifuge experience includes the design, manufacture and installation of large custom-built machines. We invite your inquiry.



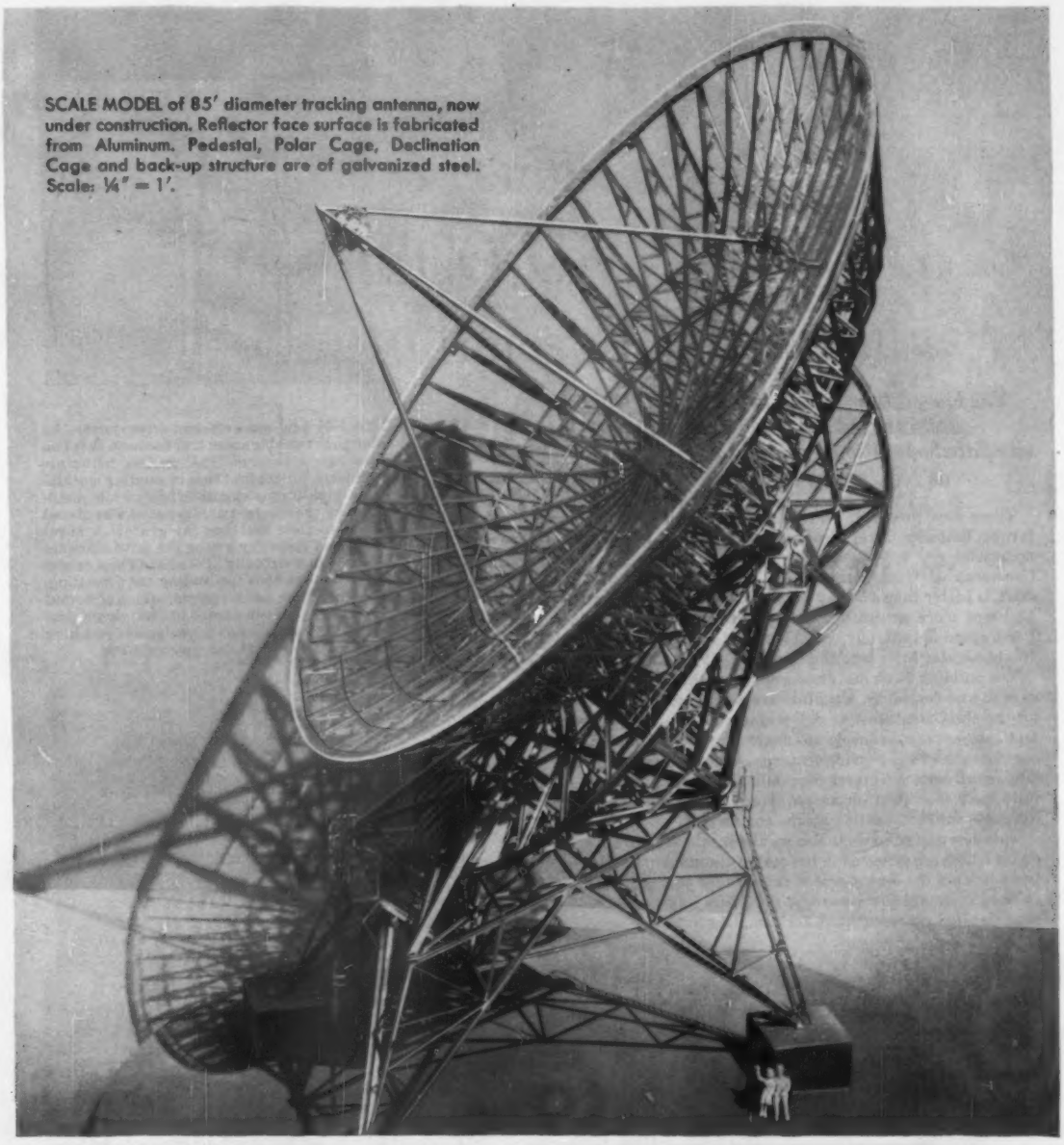
Entirely new, more efficient drive system—An integral variable speed transmission based on the new *Rouverol* *ball-galaxy principle achieves, for the first time in rotating machinery, high torque characteristics while maintaining the inherent accuracies of a hardened steel-to-steel ball-disc integrator. A novel choice of geometry among the drive elements results in a virtually linear handwheel vs rpm relationship, thus facilitating the presetting, programming and servo-controlling of output speeds. A built-in torque-limiter clutch protects the transmission from damage resulting from abuse or high inertia conditions.

*Pat. Pending



Basket-type mounting platforms, available on Model A-1020 and A-1030, may be oriented from the horizontal to the vertical or to the inverted attitude for multiple-axis testing without demounting the test object. Baskets may be raised or lowered to achieve an optimum dynamic balance and minimum angular deflections when extreme accuracies are required. When the basket is inverted the outside surface of the platform may be used to mount bulky, lightweight packages.

Available accessories include additional slip rings, servo control, microwave joints, high pressure air and hydraulic systems, TV viewing systems. Any accessory can be added *at any time* by the user. The mounting base is standard equipment.



SCALE MODEL of 85′ diameter tracking antenna, now under construction. Reflector face surface is fabricated from Aluminum. Pedestal, Polar Cage, Declination Cage and back-up structure are of galvanized steel. Scale: ¼″ = 1′.

New Blaw-Knox 85′ Diameter Tracking Antenna

This newest Blaw-Knox 85′ Diameter Tracking Antenna will be part of a telemetering operation connected with missile and satellite development.

Its design is fully determinate. All structural members of the assembly are analyzed for stress and deflection before fabrication. Coupled with shop fabrication and field erection to rigidly accurate tolerances, it is capable of the highest gain, with a minimum of distortions or aberrations.

The entire drive system embodies such critical design requirements as infinitely variable movement with negligible creep or overrun for tracking. The slewing drives are capable of the extremely rapid acceleration and deceleration necessary to focus on supersonic targets.

Pioneering like this is the latest step in a long series of Blaw-Knox developments. Such milestones as the Guyed Vertical Radiator design in AM radio, the first radar antenna used to bounce signals off the moon, and the Tropospheric Scatter Antenna for over-the-horizon television have marked Blaw-Knox as a world leader in advanced design, fabrication and erection techniques.

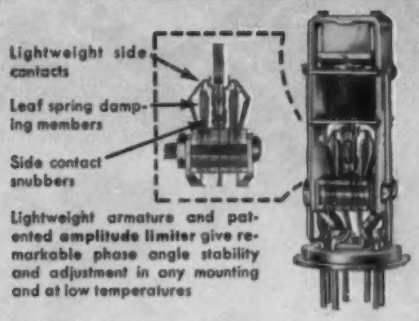
Blaw-Knox welcomes the opportunity to translate your most advanced concepts into highly reliable operating equipment. Contact the Antenna Group.

Antennas—Rotating, Radio Telescopes, Radar, Tropospheric and Ionospheric Scatter.

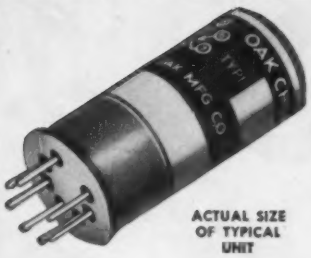
BLAW-KNOX

BLAW-KNOX COMPANY
Blaw-Knox Equipment Division
Pittsburgh 38, Pennsylvania

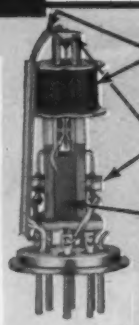
Save this Guide to Oak Choppers


Lightweight side contacts
Leaf spring damping members
Side contact snubbers
Lightweight armature and patented amplitude limiter give remarkable phase angle stability and adjustment in any mounting and at low temperatures

MINIATURE SERIES 600—MOST STABLE IN ITS CLASS



ACTUAL SIZE OF TYPICAL UNIT

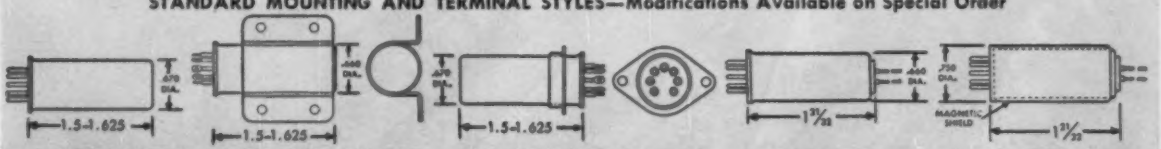

No organic materials other than Teflon are used in switch unit
All contact insulation and supports are metal-to-glass construction
Oriented ceramic magnet (patented design) eliminates parts, gives remarkable simplicity and ruggedness

MINIATURE SERIES M—
SMALLEST, MOST RUGGED IN ITS CLASS

METICULOUS ENGINEERING combined with exhaustive testing provides a line of SPDT choppers which exhibit unusual stability and low noise. While the specifications shown here are necessarily abbreviated, they will help you make a preliminary appraisal. For complete details on any unit, send us the type number and a description of your application with its circuitry.

SERIES 600—MIL C4856, Class B, Type 1. Capacity between switch terminals and ground, 15 uuf average. Contact symmetry, within 10°. Weight, less than 1 oz.
SERIES M—MIL C4856, Class B, Type 1, Grade 2. Capacity between switch terminals and ground, 3-5 uuf. Contact symmetry: 0-500 cps, within 10°; at 1000 cps, within 20°. Weight, less than ¾ oz.

STANDARD MOUNTING AND TERMINAL STYLES—Modifications Available on Special Order



FOR 7-PIN MIN. ELECTRON TUBE SOCKET | WITH BRACKET FOR PARALLEL-TO-SURFACE MOUNTING | WITH COLLAR FOR PERPENDICULAR-TO-SURFACE MOUNTING | FOR 7-PIN MIN. ELECTRON TUBE SOCKET | FOR 7-PIN MIN. ELECTRON TUBE SOCKET

	SERIES 600						SERIES M For Shock and Vibration Conditions
	Types 607, NC-600, 602, 603	Type 610	Type 604	Type 612	Type 605	Types 608, 609, NC-600A	Types M5-1, M5-2, M5-3
Nominal Drive Freq. and Voltage	400 ±20 cps at 6.3 v	400 ±20 cps at 6.3 v	380-500 cps at 6.3 v	400 ±20 cps at 6.3 v	400 ±20 cps at 6.3 v	60 ±5 cps at 6.3 v Aperiodic from 10-100 cps	4-8 Volts, 10-1000 cps. Aperiodic. Coil Current 60 ma at 400 cps Coil Res. 85 Ohms
Phase Lag at Nominal Drive Freq. and Voltage	65° ±5° at 400 cps (25° C)	65° ±5° at 400 cps (25° C)	75° ±10° at 400 cps (25° C)	90° ±10° at 400 cps (25° C)	180° +10° −0° at 400 cps (25° C)	20° ±5° at 60 cps (25° C)	10 cps: 10° ±5° 60 cps: 15° ±5° 400 cps: 55° ±10° 1000 cps: 110° +0° −0° (25° C)
Contact Dwell Time at Nominal Drive Freq. and Voltage	150° min (25° C)	140° max (25° C)	150° min (25° C)	150° min (25° C)	160° ±10° (25° C)	165° to 170° at 60 cps	160° to 170° (25 °C)
Contact Rating Into Resistive Load (Maximum)	CONTINUOUS: 10 v at 2 ma INTERMITTENT: 15 v at 2 ma	CONTINUOUS: 50 v at 2 ma INTERMITTENT: 100 v at 2 ma	CONTINUOUS: 10 v at 2 ma INTERMITTENT: 15 v at 2 ma	CONTINUOUS: 10 v at 2 ma INTERMITTENT: 15 v at 2 ma	CONTINUOUS: 50 v at 2 ma INTERMITTENT: 100 v at 2 ma	CONTINUOUS: 15 v at 2 ma INTERMITTENT: 50 v at 2 ma	CONTINUOUS: 10 v at 1 ma INTERMITTENT: 12 v at 2 ma
Life Expectancy (Optimum Conditions)	Up to 5000 hours	Up to 1000 hours	Up to 5000 hours	Up to 5000 hours	Up to 5000 hours	Up to 10,000 hours	Up to 10,000 hours
Switching Speed With DC in Coil	Less than 1 Millisecond	Less than 1 Millisecond	Less than 1 Millisecond	Less than 1 Millisecond	Less than 1 Millisecond	Less than 800 Microseconds	Less than 200 Microseconds

OAK MFG. CO.

1260 Clybourn Ave., Dept. G Chicago 10, Illinois
Phone: MOhawk 4-2222

SWITCHES CHOPPERS VIBRATORS
ROTARY SOLENOIDS TUNERS
PACKAGED CIRCUITRY

BUSS Fuses provide Maximum Protection *against damage due to electrical faults*

When an electrical fault occurs, BUSS fuses quickly clear the circuit. By preventing useless damage, BUSS fuses help to get your equipment back in operation sooner. Users of your equipment are safeguarded against the expense of unnecessary repair bills.

BUSS fuse dependability also prevents needless blows that 'knock' equipment out-of-service without cause. Users are protected against irritating and often costly shutdowns due to faulty fuses blowing when trouble does not exist.

Electronic Testing Assures Dependability in BUSS Fuses

Every BUSS fuse is tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

By specifying BUSS fuses, you are providing the finest electrical protection possible, — and you are helping to safeguard the reputation of your product for quality and reliability. To meet your needs, the BUSS fuse line is most complete.

If you have an unusual or difficult protection problem . . . let the BUSS fuse engineers work with you and save you engineering time. If possible, they will suggest a fuse already available in local wholesalers' stocks, so that your device can easily be serviced.

For more information on BUSS and FUSETRON Small Dimension fuses and fuseholders, write for bulletin SFB.

Bussmann Mfg. Division McGraw-Edison Co., University at Jefferson, St. Louis 7, Mo.

BUSS fuses are made to protect – not to blow, needlessly

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

A COMPLETE LINE OF FUSES FOR HOME, FARM, COMMERCIAL, ELECTRONIC, AUTOMOTIVE AND INDUSTRIAL USE.

1058

now, most flexible line of PNP Germanium Power Transistors

40 Watts* 30 Watts* 20 Watts*

Collector dissipation at 25°C with infinite heat sink.

3 POWER GROUPS

5 PACKAGES

MORE THAN 100 TYPES

40-WATT GROUP
Types Available

Current Gain‡	30V	60V	80V	100V	Packages#
160	LT-5096	LT-5105	LT-5114	LT-5123	Diamond
	LT-5095	LT-5104	LT-5113	LT-5122	Male
	LT-5094	LT-5103	LT-5112	LT-5121	Female
80	LT-5093	LT-5102	LT-5111	LT-5120	Diamond
	LT-5092	LT-5101	LT-5110	LT-5119	Male
	LT-5091	LT-5100	LT-5109	LT-5118	Female
40	LT-5090	LT-5099	LT-5108	LT-5117	Diamond
	LT-5089	LT-5098	LT-5107	LT-5116	Male
	LT-5088	LT-5097	LT-5106	LT-5115	Female

Minimum Breakdown Voltage†

30-WATT GROUP
Types Available

Current Gain‡	30V	60V	80V	100V	Packages#
100	LT-5060	LT-5069	LT-5078	LT-5087	Diamond
	LT-5059	LT-5068	LT-5077	LT-5086	Male
	LT-5058	LT-5067	LT-5076	LT-5085	Female
60	LT-5057	LT-5066	LT-5075	LT-5084	Diamond
	LT-5056	LT-5065	LT-5074	LT-5083	Male
	LT-5055	LT-5064	LT-5073	LT-5082	Female
30	LT-5054	LT-5063	LT-5072	LT-5081	Diamond
	LT-5053	LT-5062	LT-5071	LT-5080	Male
	LT-5052	LT-5061	LT-5070	LT-5079	Female

Minimum Breakdown Voltage†

20-WATT GROUP
Types Available

Current Gain‡	30V	60V	100V	120V	Packages#
60	LT-5028	LT-5034	LT-5042	LT-5051	Diamond
	LT-5027	LT-5033	LT-5041	LT-5050	Male
	LT-5026	LT-5032	LT-5040	LT-5049	Female
40	LT-5025	LT-5031	LT-5039	LT-5048	Diamond
	LT-5024	LT-5030	LT-5038	LT-5047	Male
	LT-5023	LT-5029	LT-5037	LT-5046	Female
20	LT-5022	2N157	2N157A	LT-5045	Diamond
	LT-5021	LT-55	LT-5036	LT-5044	Male
	2N156	2N158	LT-5035	LT-5043	Female

Minimum Breakdown Voltage†

‡Minimum large-signal current gain: 40-watt group at 1.0 A, 30-watt group at 0.75 A, 20-watt group at 0.50 A.

†Minimum breakdown voltage, collector to base with emitter open.

#Five packages: diamond, female industrial with solder lugs or flying leads, and male industrial with solder lugs or flying leads.

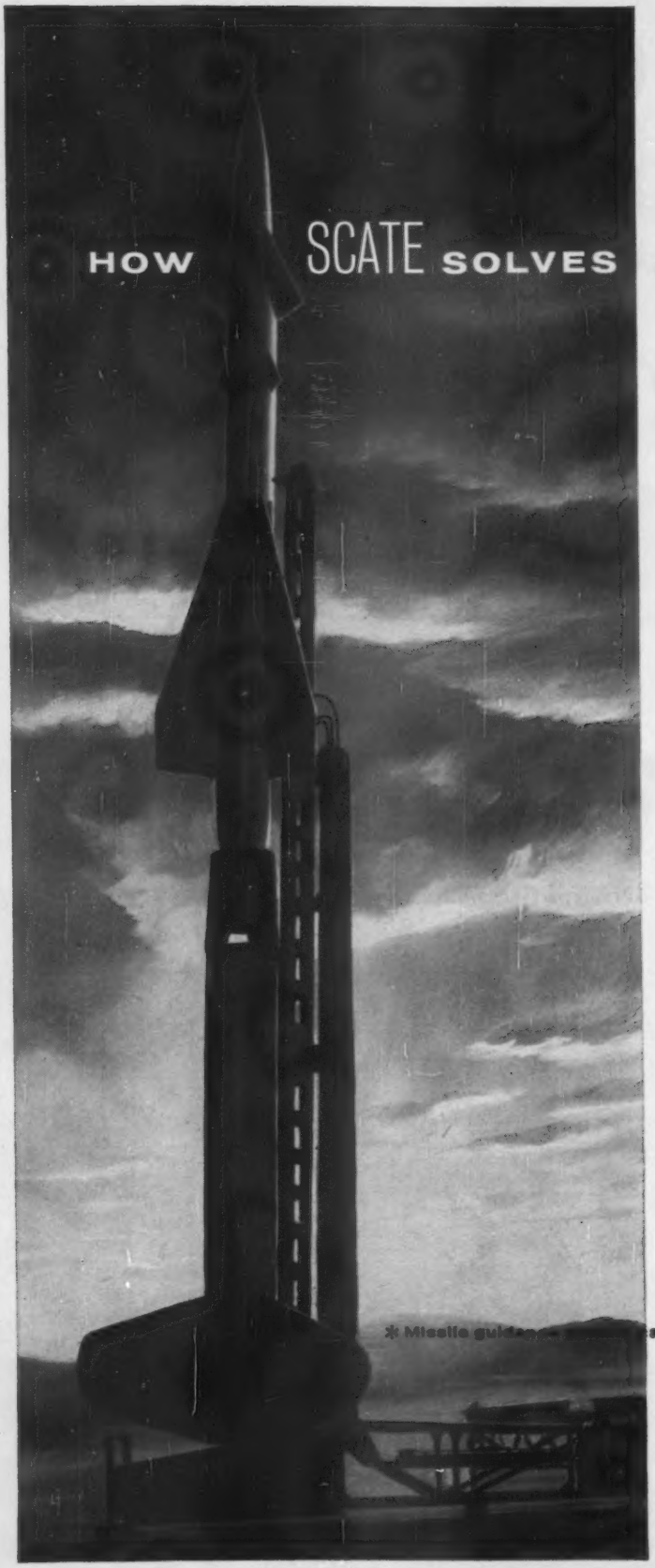
Reliable products through Advanced-Engineering

CBS semiconductors

CBS-HYTRON, Semiconductor Operations, Lowell, Mass.
A Division of Columbia Broadcasting System, Inc.
Sales Offices: *Newark, N. J.; Melrose Park, Ill.; Los Angeles, Calif.*

Whatever your needs in PNP germanium power transistors, CBS-Hytron can supply them: In a choice of three sizes of collector dissipations . . . 20, 30 or 40 watts. In a choice of five packages . . . diamond, female industrial with solder lugs or flying leads, and male industrial with solder lugs or flying leads. And in 36 choices of collector-to-base voltages and large-signal current gains.

See tables for types available. Write today for Bulletin E-288 giving complete data on EIA, military and special types in the widest range of current gains, collector voltages and currents available. Let the unsurpassed flexibility and width of this CBS-Hytron line help solve your individual power transistor problems.



HOW SCATE SOLVES 2 BASIC PROBLEMS in testing electronic systems

Many complex electronic systems—missile guidance is a good example—may require testing that takes days by conventional methods. Yet the end function of such a system may last only a few minutes—**even seconds.**

Other systems, though less complex, must be tested in such large numbers that adequate personnel are frequently unavailable to perform tests by conventional means.

The SCATE system of automatic test equipment can solve **both** problems. It provides **self-checking** automatic testing which is **fast, flexible** and **foolproof.**

The system evaluates all important parameters of equipment under test, including:

1. RF sensitivity, center frequency, band width, power output, noise figure.
2. Audio frequency gain, band width, power output.
3. Video pulse circuitry, including pulse decoding, logic, digital comparison, pulse delays.
4. Voltage levels, DC and AC.
5. Servo response.
6. Mechanical response.

Stromberg-Carlson has standing designs for all the standard components which go into a SCATE system, and is fully experienced in designing custom components which may be required in any test system.

Complete details on the SCATE system and other Stromberg-Carlson automatic test equipment are available on request.

* Missile guida[illegible]an be tested automatically by the SCATE system.

"There is nothing finer than a Stromberg-Carlson"

STROMBERG-CARLSON
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Electronic and communication products for home, industry and defense

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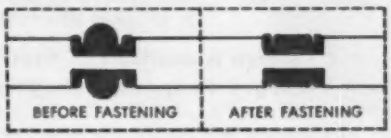
Featuring... NO LEAKAGE
plus electrical continuity with no arcing or burning!

These wave guide seals, developed by Parker Seal Company offer leak-proof effective sealing while affording electrical continuity with provision for prevention of R/F leakage and interference. In addition they afford considerable savings by requiring simple, less expensive flanges and quick easy assembly. They assure visual installation inspection and are re-useable.

Series 5600 fits all EIA (RETMA) L-band guides WR90 thru WR2300. Others for X-band guides, as well as specials. For complete details send for catalog.



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A DIVISION OF Parker Hannifin CORPORATION
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* formerly Franklin C. Wolfe Co.

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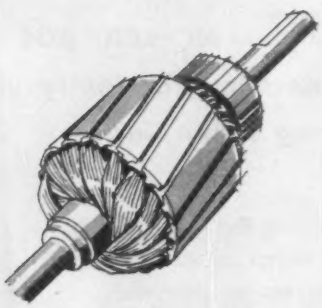
WIRE SX PRODUCTS ®

SODERON (nylon coated Soderex)

WINDS EASIER



Low co-efficient of friction provides "lay-in" qualities similar to tried and true Nyform (nylon coated Formvar).

RESISTS SOLVENTS

The chemically resistant outer jacket removes any danger of magnet wire damage by severe varnish or compound treatments.

SOLDERABLE, TOO!

No stripping. Solderable at low temperature without damage to copper conductor.

SX Soderon is available in sizes 10-46 AWG, inclusive. Packaged on spools, reels, pails and "Magna Pak".®

Wire designed with the future in mind . . . Essex "field tested" Magnet Wire

MAGNET WIRE DIVISION, Essex Wire Corp., Fort Wayne 6, Indiana

Manufacturing Plants: **Birmingham, Alabama; Anaheim, California; Fort Wayne, Indiana; Hillsdale, Michigan**

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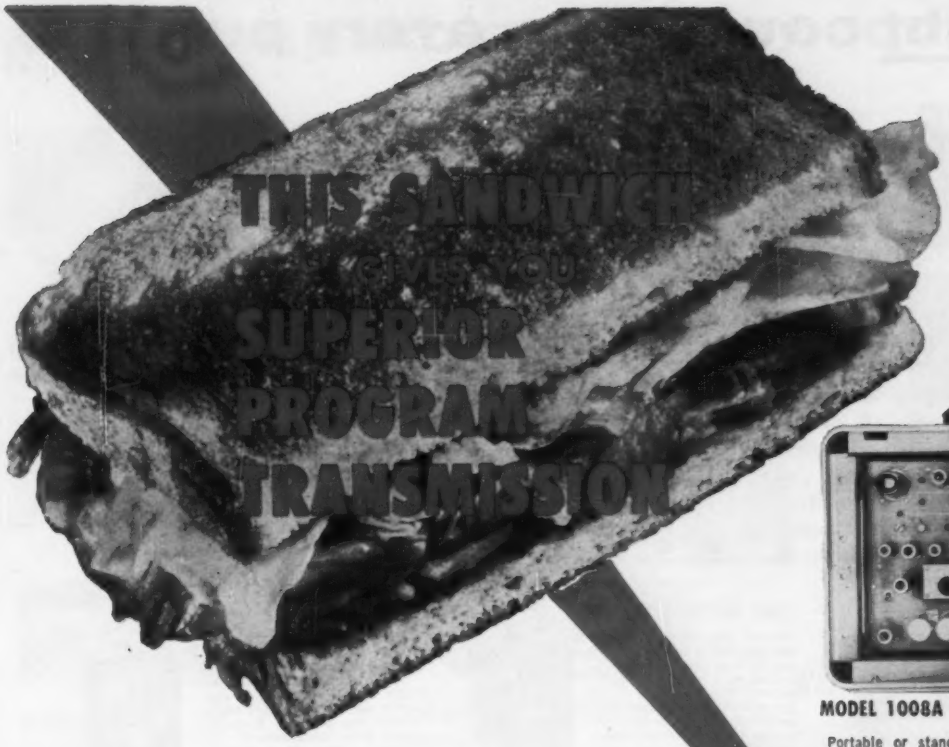
NATIONAL NETWORK OF WAREHOUSES AND SALES OFFICES . . . CALL YOUR LOCAL "ESSEX MAN"



TELECHROME

VERTICAL BLANKING INTERVAL TEST SIGNAL KEYER 1008-A

The Telechrome Model 1008-A Vertical Blanking Interval Keyer is a self-contained portable unit that makes possible transmission of television test and control signals between frames of a TV picture. Any test signal (multiburst, stairstep, color bar, etc.) may be added to the composite program signals. The keyer will operate anywhere in the TV system and operates from composite video, sync, or H & V drive. The test signals are always present for checking transmission conditions without impairing picture quality. The home viewer is not aware of their presence.

These continuous reference signals may be used in connection with various Telechrome devices for automatic correction of video level, frequency response, envelope delay, differential gain and differential phase.

IMPORTANT: Checking after programming is costly and at best highly inefficient since conditions constantly vary. The Telechrome Vertical Interval Keyer minimizes post-program checking and overtime expenses. It provides instant indication of deteriorating video facilities so that corrective measures can be undertaken immediately — manually or automatically during programming.

Now in use by CBS, NBC, ABC, BBC ITA (Brit.), NHK (Japan)

Write for Specifications & Details

COLOR TV • INDUSTRIAL INSTRUMENTATION • TELECASTER

TELECHROME

AT THE FRONTIERS OF ELECTRONICS

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AMITYVILLE, N.Y.
Lincoln 1-3600
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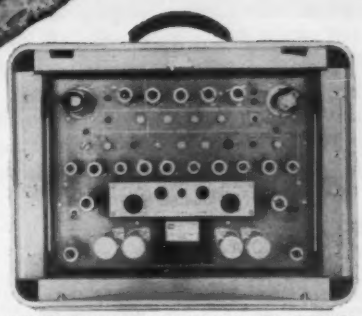
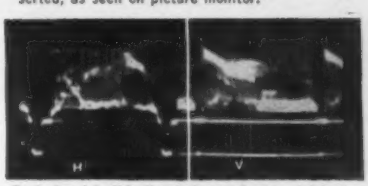


MODEL 1008A VERTICAL BLANKING INTERVAL TEST SIGNAL KEYER

Portable or standard rack mounting. Self-contained regulated power supply.

Video picture with multiburst test signal inserted, as seen on picture monitor.



Test signal is thin line between frames. All test signals can be transmitted during vertical blanking portion of video signal.

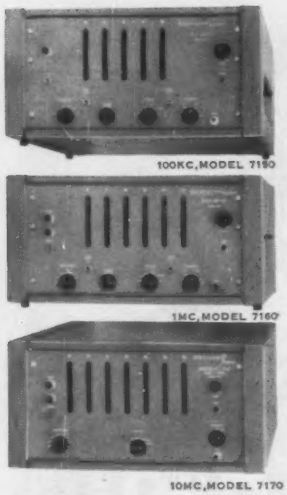
1003-C VIDEO TRANSMISSION TEST SIGNAL GENERATOR

Completely self-contained, portable. Produces multi-frequency burst, stairstep, modulated stairstep, white window, composite sync. Variable duty cycle. Regulated power supply. 12¼" standard rack mounting or in carrying case. Integrates with above model 1008-A Test Signal Keyer.

1043-DR VERTICAL INTERVAL DELETER-ADDER

Integrates with model 1008-A to recognize incoming test signals. Deletes incoming test signals and/or adds new test signals.

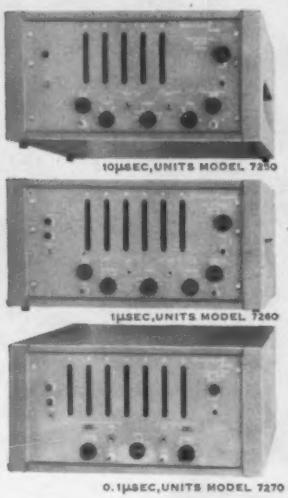
The right counter for every purpose



EPUT® METERS

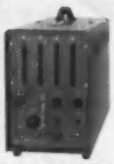
Long considered standard equipment for making rapid, precise frequency measurements, Berkeley EPUT meters are now available with over twenty standard modifications designed for an ever-broadening variety of applications. Most EPUT meters are equipped to make period measurements of low frequency signals.

5210 PORTABLE 100KC

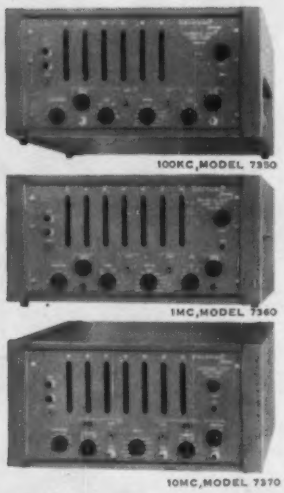


TIME INTERVAL METERS

The full line offers meters of four degrees of precision ranging from a tenth of a millisecond to a tenth of a microsecond. Versatile 7000 Series instruments feature selectable sensitivity for noise discrimination, trigger level adjustable over a wide range, slope selection and very high input impedance.



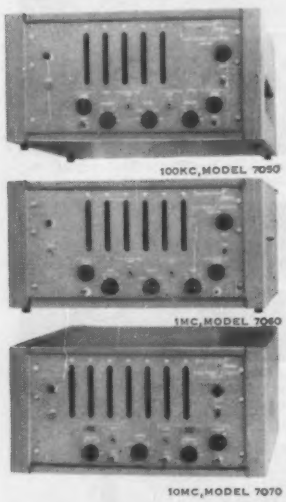
5220 PORTABLE, 100μSEC UNITS



UNIVERSAL EPUT AND TIMERS

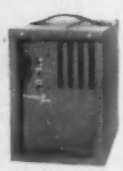
Combining the functions of an EPUT meter and time interval meter in a compact economical package, these instruments are widely preferred as general purpose laboratory equipment for precise frequency and time measurement. Universal instruments feature as many as ten distinct operating functions.

5230 PORTABLE



GATING COUNTERS

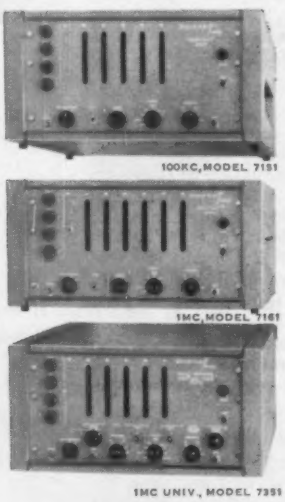
The counting interval of these instruments can be accurately controlled by a broad variety of input signals. Widely useful as a systems building block, several of these units will perform as EPUT meters or time interval meters when operated in conjunction with an independent source of time signals.



MODEL 5804

INDUSTRIAL TOTALIZING COUNTERS

Berkeley makes rugged counters with top speeds from 125 cps to 10,000 cps and capacities up to one billion counts. Model 5805 utilizes miniature magnetic amplifiers for long-term trouble-free operation.

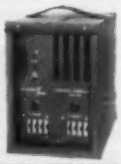


PRESET EPUT METERS

These instruments will create direct digital indications of rotating speed, flow, pressure, temperature and similar physical quantities in any desired units —for example, rpm, gals/sec, psi, etc. Direct indication is made possible by a counting interval variable over a wide range in small increments.

COUNTER-CONTROLLERS

Counters which deliver output signals when selected numbers are reached are widely used for precise control of diverse operations. Output signals may be relay closures, sharp voltage pulses or changes in dc level. 5400 Series instruments operate at speeds up to 40,000 counts per second and deliver output signals at one or two preset totals. 5800 Series controllers utilize miniature magnetic amplifiers for maximum reliability in industrial control applications. Operable at speeds up to 5000 counts per second, these units are obtainable with from 1 to 12 preset points.



MODEL 5820 SERIES

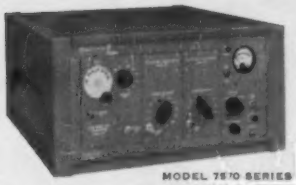
Beckman®

Berkeley Division

2200 Wright Avenue, Richmond 3, California

a division of Beckman Instruments, Inc. T-4

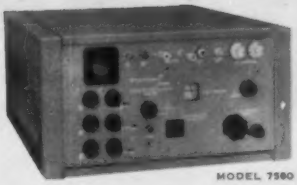
plus compatible auxiliary equipment



MODEL 7570 SERIES

EXTEND FREQUENCY MEASUREMENT TO 1000 Mc.

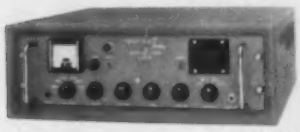
Model 7570 Series heterodyne converters extend frequency measuring range of 10 Mc EPUT meters with increased accuracy and sensitivity. Equipped with from one to three converters, all simultaneously housed in the cabinet shown, the range can be extended to 110 Mc, to 220 Mc or to 1000 Mc. Sensitivity of one milliwatt or better insures that loading effects will not distort measurements of weak signals.



MODEL 7580

EXTEND FREQUENCY MEASUREMENT TO 12,000 Mc.

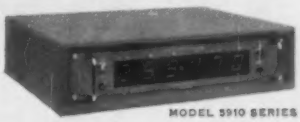
Digital presentations of frequencies up to 12,000 Mc can be obtained with the Model 7580 computing transfer oscillator operated with a universal EPUT and Timer. Built-in computer calculates harmonic number which, preset into counter, creates a decimal display of actual frequency under test. With no manual calculations, measurements are ordinarily performed in one fifth the time previously required.



MODEL 905

RECEIVE WWV FOR CALIBRATION

The crystal-controlled oscillator in EPUT meters and timers can be rapidly and precisely calibrated by bringing a harmonic to zero beat with a WWV standard frequency. The Model 905 receives WWV frequencies of 2.5, 5, 10, 15, 20 and 25 Mc. The choice of six transmission frequencies insures reception under adverse conditions. A front-panel meter provides a visual indication of exact zero beat.



MODEL 5910 SERIES

OBTAIN LARGE IN-LINE INDICATIONS

Plugged into a readout socket present on nearly all Beckman counters, 5910 Series indicators display the counter reading in bright red digits 1¼ inches high. The display can be read from nearly any angle and in bright light—even sunlight. Indicator can be located nearby or at a remote point.

MODEL 1452

PRINT READINGS ON PAPER TAPE

Plugged into a counter readout socket, the Model 1452 prints each counter indication successively on a standard adding machine tape. Ideal for stability checks, recording transients or simply procuring a permanent printed record of measurements.

MODEL 7700

MAKE OFF-THE-AIR FREQUENCY MEASUREMENTS

A unique combination of a high quality communications receiver with an EPUT meter, the Model 7700 enables an operator to measure a carrier frequency simply by tuning the receiver to the transmitted signal and reading the precise digital indication presented by the EPUT meter. A transfer oscillator is incorporated for use in measuring interrupted carriers and frequency-shift transmission.

TRANSDUCERS

Berkeley manufactures a variety of transducers which translate physical events into electrical pulses suitable for counting and timing purposes. Shown above are a few tachometer pick-ups and photoelectric sensing elements.

and many more standard and special-purpose instruments

Beckman/Berkeley manufactures several times the number of products pictured on this page. Of particular interest are standard modifications to meet the many diverse counter applications which have come to our attention. In addition, our Special Products Department, constructs auxiliary equipment, such as input scanners, output data converters and other equipment to meet individual customer requirements.

WANT MORE INFORMATION?

Specific

For a detailed technical bulletin on any instruments shown here write Beckman/Berkeley, 2200 Wright Avenue, Richmond, California. Be sure to specify model numbers.

General

Short form catalog C706 contains 16 pages of information on these and other instruments. Write or fill out reader service card, if provided.

Choosing from a complete, diversified line means...

FULL PERFORMANCE

You can get an instrument that meets all your requirements.

LOWER COSTS

No need to purchase unnecessarily complex equipment for a limited job.

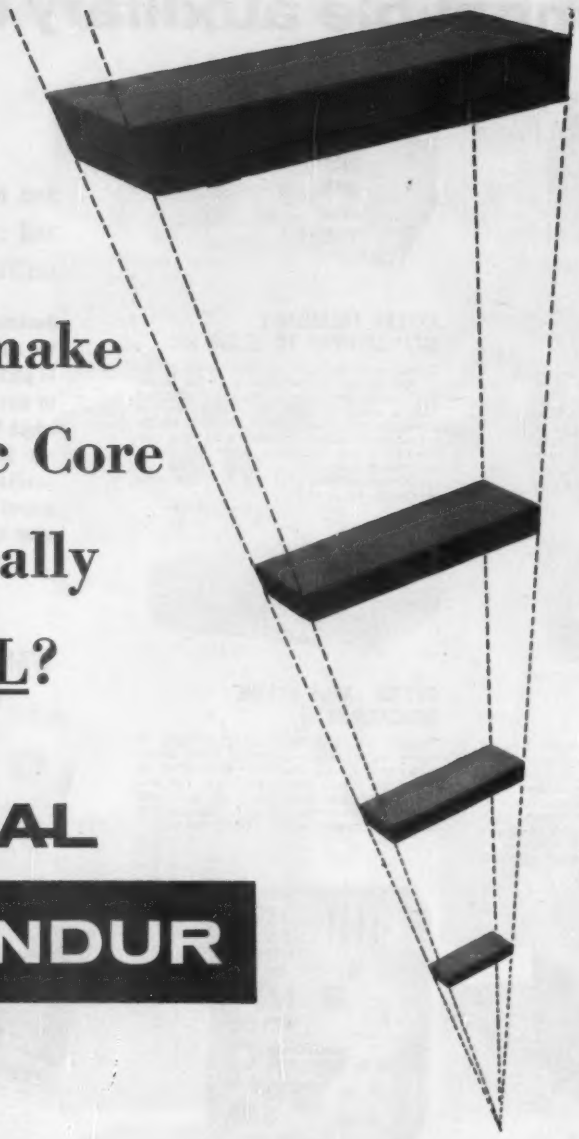
REDUCED OBSOLESCENCE

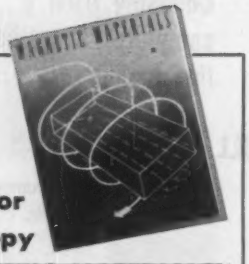
New needs can often be met by expanding rather than replacing existing equipment.

T-5

How to make a Magnetic Core that's really SMALL?

use AL PERMENDUR





Write for your copy "MAGNETIC MATERIALS"

This 32-page book contains valuable data on all Allegheny Ludlum magnetic materials, silicon steels and special electrical alloys. Illustrated in full color, includes essential information on properties, characteristics, applications, etc. Your copy gladly sent free on request.

ADDRESS DEPT. E-10

When the conditions of service make it imperative for you to hold the size and weight of magnetic cores at an absolute minimum, that's the place to use Permendur. With it you can push the flux density up to 20 kilogausses, and practically eliminate weight as a consideration.

Along with its suitability for cores wherever the premium is laid on compactness, Permendur is just the thing for sonar magnetostriction applications, too. We maintain proper annealing facilities for this alloy. Write for technical data on it, and let our engineers help you to cash in on its possibilities.

In addition to Permendur, we offer a range of high-permeability alloys, oriented silicon steels and other electrical alloys that is unmatched in its completeness. Our services also include the most modern facilities for lamination fabrication and heat treatment.

Let us supply your requirements. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

STEELMAKERS to the Electrical Industry

Allegheny Ludlum

WSW 6110

AL STEELS FOR THE ELECTRONIC AGE

CIRCLE 42 READERS SERVICE CARD

CIRCLE 43 READERS SERVICE CARD→

PULSE

GENERATION

Five plug-in pulse generators provide any code—1 to 5 pulses—with completely independent adjustment of width and delay for each pulse.

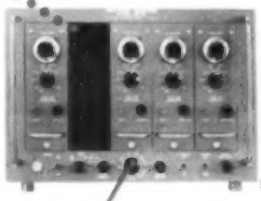
PULSE DELAY:
variable 0 to 300 microseconds

PULSE WIDTH:
variable 0.2 to 2 microseconds

PULSE TIME MODULATION:
Sensitivity, 2 volts RMS per microsecond

CODED MULTIPULSE GENERATOR

Model MP-1A



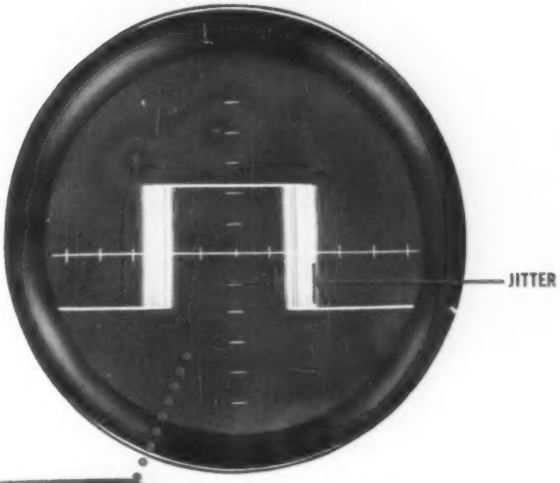
RISE AND DECAY TIME:
0.1 microsecond

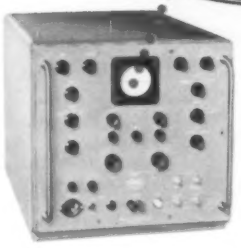
GROUP REPETITION RATE:
10 to 10,000 pps

Used to modulate r-f signal generators with coded pulse groups. Internal or external sync; square wave output, 10 to 10,000 pps. Pulses can be independently pulse-time modulated by external signal.

APPLICATIONS: Design and testing of missiles, radar, beacons, IFF, telemetry, etc.

TESTING





PULSE JITTER TESTER

Model PJ-1

Displays the magnitude and waveform of pulse jitter (time deviation) in rate generators, pulse width modulators, encoding devices and precision time generators.

MEASURES:

PULSE WIDTH JITTER: Peak-to-peak time deviation ($\triangle T$) at the half-amplitude points, between the leading and trailing edges of a recurrent pulse having a nominal width represented as "T" in the diagram at left.

ABSOLUTE JITTER: Time deviation ($\triangle T$) at the half-amplitude points, from leading edge to leading edge of successive pulses (of duration "T" in the diagram) in a pulse train.

RELATIVE JITTER: Peak-to-peak time deviation ($\triangle T$) at half-amplitude points of the leading edge of one pulse to the leading edge of a reference pulse. The time difference between the two is "T" in the diagram.

Repetition Rate Jitter: 5 millimicroseconds to 100 microseconds full scale. **Relative or Width Jitter:** 5, 10, 100 millimicroseconds.

FREE LIFETIME SERVICE ON ALL POLARAD INSTRUMENTS

MAIL THIS CARD
for complete specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements"

POLARAD ELECTRONICS CORPORATION
43-20 34th Street Long Island City 1, N. Y.
Representatives in principal cities

POLARAD ELECTRONICS CORPORATION:

E
EDN

Please send me information and specifications on:

- ☐ Model MP-1A Coded Multi-Pulse Generator
- ☐ Model PJ-1 Pulse Jitter Tester
- ☐ Model VS-2 Rapid-Scan Ratio-Scope (see reverse side of page)
- ☐ Model ESG Electronic Sweep Generator (see reverse side of page)

My application is:_____

Name_____

Title_____ Dept._____

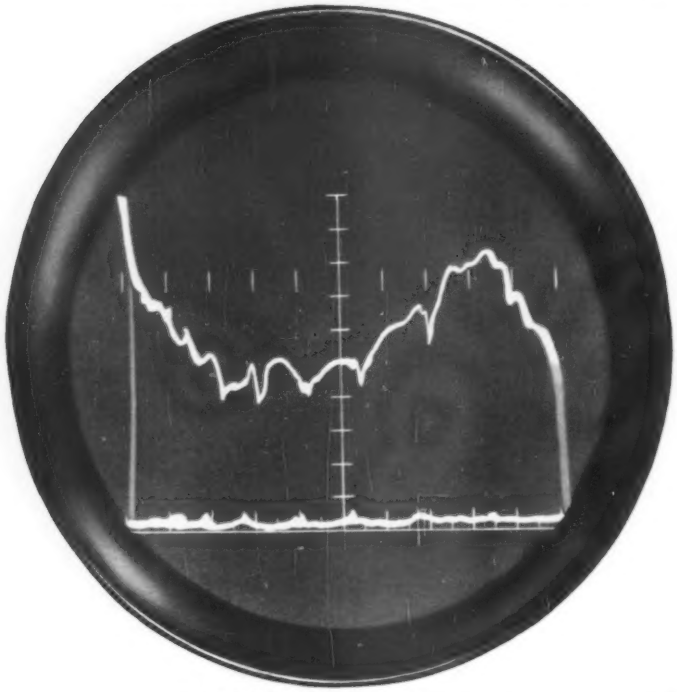
Company_____

Address_____

City_____ Zone____ State_____

INSTANTANEOUS MICROWAVE ANALYSIS

SINGLE FREQUENCY OR OVER A FULL OCTAVE



Complete VSWR pattern of a microwave component over an entire frequency octave is displayed on a calibrated 7" CRT.

Saves Engineering Manhours

1,000 to 15,000 mc

ELECTRONIC SWEEP GENERATOR

Model ESG 1,000-15,000 mc

Sweep width continuously adjustable, single frequency to an entire octave.

RAPID SCAN RATIO-SCOPE

Model VS-2

Displays the ratio of two input signals; gives visual plot of VSWR as a function of frequency.

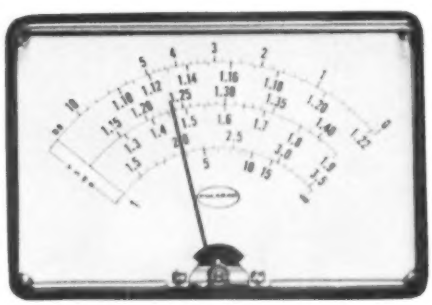
Measure and Analyze:

VSWR, transmission and reflection coefficients, gain and attenuation, image rejection, sensitivity, selectivity, bandwidth and filter characteristics, antenna patterns, etc.

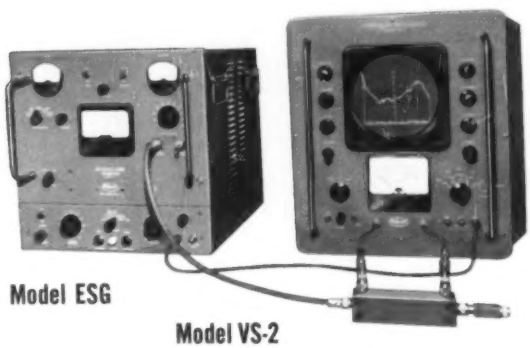
Microwave Components:

Radars, receivers, beacons, waveguides, antennas, pads, terminations, couplings and hybrid junctions, attenuators, crystal mounts, preselectors, amplifiers.

Instantaneous measurements at a single frequency or over an entire swept frequency range can be obtained with an Electronic Sweep Generator and a Rapid-Scan Ratio Scope



VSWR at any single frequency is indicated on the Ratio-Scope front panel meter.



Model ESG

Model VS-2

Typical set-up for measuring VSWR of a microwave component. Directional coupler outputs feed incident and reflected signals separately into the Ratio-Scope. Scope displays the pattern of the ratio between the two inputs over the entire frequency range swept.

Postage Will be Paid by Addressee

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First Class Permit No. 18, Long Island City 1, N.Y.

POLARAD ELECTRONICS CORP
43-20 34th St., Long Island City 1, N. Y.

POLARAD

MAIL THIS CARD
for complete specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements"

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POLARAD ELECTRONICS CORPORATION

43-20 34th Street Long Island City 1, N. Y.

Representatives in principal cities

How You Can Cut Product Costs With Indox V Ceramic Magnets

Experience in the design and production of Indox V, for such products as the loudspeaker below, points the way to substantial savings in manufacturing costs for other products using permanent magnets.

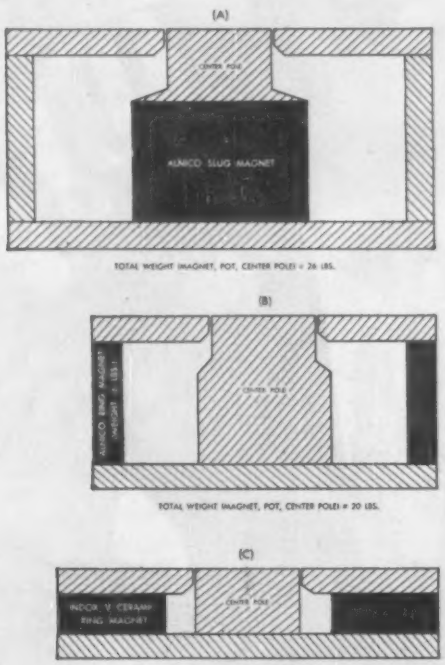
WHAT IS INDOX V

Indox V is a highly oriented barium ferrite material. Its energy is comparable, on an equivalent weight basis, to that of Alnico V—the most powerful permanent magnet material available. Indox V magnets possess unique advantages — light weight, high-electrical resistivity, great resistance to demagnetization, and inexpensive, non-critical raw materials — plus an energy product over three times that of non-oriented ceramic magnets.

NEW INDOX V LOUDSPEAKER DESIGN...

• Cuts magnet cost 20% • Saves 25% on weight • Reduces length 46%

High fidelity, permanent magnet loudspeakers normally use an Alnico slug (A) or ring (B) magnet. Assembly (C) illustrates how one loudspeaker was redesigned to use Indox V, with the results indicated. Assemblies shown in proportion.


(A)
ALNICO SLUG MAGNET
TOTAL WEIGHT (MAGNET, POT, CENTER POLE) = 26 LBS.
(B)
ALNICO RING MAGNET
TOTAL WEIGHT (MAGNET, POT, CENTER POLE) = 20 LBS.
(C)
INDOX V CERAMIC RING MAGNET
TOTAL WEIGHT (MAGNET, POT, CENTER POLE) = 15 LBS.

APPLICATIONS

Indox V's excellent magnetic qualities and special properties suggest wide usage in many applications.

Among them:

D. C. Motors of Medium Size with Indox V fields have a high efficiency and show high starting and stall torques characteristic of series wound motors.

Holding Devices can take advantage of Indox V's total potential energy which, per pound of magnet weight, is appreciably higher than that of Alnico V.

Torque Drives using Indox V discs can be magnetized with multiple-pole faces.

The list of other promising applications is growing.

WHO MAKES INDOX V

Only Indiana Steel Products makes this oriented ceramic magnet, with an energy product of 3.5 million B_dH_d. And, because Indiana also produces Alnico and all other permanent magnet materials, it is uniquely qualified to recommend the *one* best material for your design. You are invited to consult with Indiana's design engineers for expert help on any application involving permanent magnets.

SEND FOR FREE LITERATURE

Write for your copy of the bulletin "Indox V Ceramic Permanent Magnets," describing magnetic properties, design considerations, and sizes and shapes available from stock for experimental work. Ask for Bulletin No. 18-A10.

THE INDIANA STEEL PRODUCTS COMPANY
VALPARAISO, INDIANA

WORLD'S LARGEST MANUFACTURER OF PERMANENT MAGNETS

INDIANA PERMANENT MAGNETS

IN CANADA: The Indiana Steel Products Company of Canada Limited, Kitchener, Ontario

A Statement By
I. D. DANIELS, GENERAL MANAGER
RECEIVING TUBE DEPARTMENT
GENERAL ELECTRIC COMPANY

TODAY'S TV-

For further information, phone nearest office of the G-E Receiving Tube Department below:

EASTERN REGION
200 Main Avenue, Clifton, New Jersey
Phones: (Clifton) GRegory 3-6387
(N.Y.C.) WIsconsin 7-4065, 6, 7, 8

CENTRAL REGION
3800 North Milwaukee Avenue
Chicago 41, Illinois
Phone: SPring 7-1600

WESTERN REGION
11840 West Olympic Boulevard
Los Angeles 64, California
Phones: GRanite 9-7765; BRadshaw 2-8566

MARKET DEMAND: *Reliability!*

- **Consumers now want reliability in addition to good reception, quality pictures, and advanced styling.**
- **General Electric meets this need with new, complete line of *Service Designed* reliable tubes for TV—dependable, backed by experience in military tube design and manufacture.**
- **Production and field failures reduced, costs cut for set manufacturers.**

Today's market for television sets calls for high standards of receiver performance. Having experienced, over the years, the benefits of a constantly improving product, buyers are accustomed to the best in picture reception. Now they are adding reliability to their demands.

As a leading supplier of receiving tubes, we at General Electric have been aware of the television buying public's increasing insistence on quality performance *all* the time. Moreover, there is a growing awareness on the part of TV manufacturers that tube reliability is fundamental to good set performance—that, as sometimes is said, "a receiver is as good as the tubes that are in it."

Charged with helping manufacturers supply superior sets to an exacting market, General Electric now has applied its resources, skills, and equipment to building greater reliability into 70 G-E Service-Designed Tubes for television. The range of these 70 types encompasses virtually every socket requirement.

5-STAR HIGH-RELIABILITY EXPERIENCE APPLIED

Flying safety, fire-control accuracy, missile dependability: these and other critical needs for military tube reliability have given General Electric wide experience in high-reliability manufacturing techniques.

The methods found essential for reducing military tube inoperatives and stabilizing tube performance have been heavily drawn on to increase the reliability of General Electric tubes for television.

An example of such methods is "Snow White" manufacture. G-E workers who assemble tubes for TV now wear lint-free dacron and nylon garments. Air is filtered and conditioned to keep out dust and lint, the most frequent causes of short-circuits throughout tube life.

NINE ACROSS-THE-BOARD RELIABILITY ADVANCES

Besides lint-free, dust-free manufacture, eight important across-the-board steps are being taken to promote increased reliability in G-E tubes for television. Many more improvements are being made to individual types.

New tests are more exacting than any before applied to tubes for TV. An accelerated heater-cycling test assures that tubes will perform properly under wide variations in household line voltage. A new G-E-developed direct-current testing method for shorts and opens has 500% greater sensitivity and eliminates human-operator error.

Glass-strain specification tests have been tightened to a point where they match strict military-tube requirements. G-E life tests now are twice as rigid as the JAN specifications for tubes in the entertainment class.

Other important across-the-board advancements are being made in materials and manufacturing processes. On individual tubes, as many as 20 specific improvements bring higher dependability than ever before.

SAVINGS TO TV MANUFACTURERS

In addition to entrenching set manufacturers in a TV market that demands quality performance at all times, General Electric's new Service-Designed tube program offers cost savings that are direct and apparent.

First: fewer production-line slowdowns from tube failures. Second: less "dead inventory" of receivers in the factory that won't pass final inspection and must be reworked. Third: lower warranty costs, once sets have been shipped and delivered.

GET THE FULL RELIABILITY STORY!

The complete account of what G.E. has done to increase tube reliability is far too comprehensive to appear here. Among the many improvements, however, are specific steps that will interest every member of your designing staff.

I recommend, therefore, that you contact your nearest G-E Receiving Tube Department office at left, and ask for a G-E tube engineer to call at your convenience.

Besides posting you fully on the over-all General Electric reliability program, he will be glad to review with you the details of this program, tube by tube, as they affect TV circuits now in production, in the breadboard stage, or on your designers' drawing-boards.

L. D. Daniels

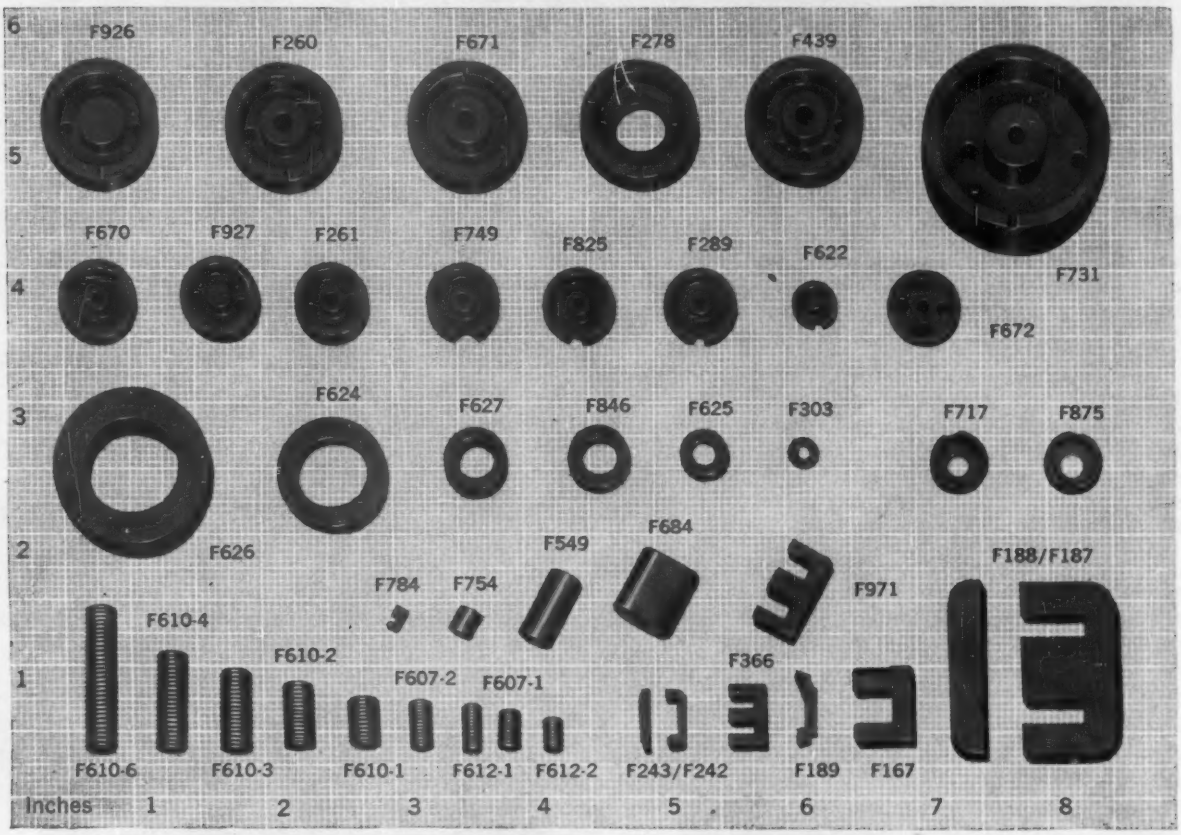
Progress Is Our Most Important Product

GENERAL ELECTRIC

12-11-103

Now, Immediate Delivery from Stock on

GENERAL CERAMICS SPECIAL PURPOSE FERRITE CORES



Rush service for designers – use this handy materials selector chart

Ferrite Cores available in various materials for development and design engineers to cover specific frequency bands of operation from 1 KC to 50 megacycles. General Ceramics provides extra-fast service on sample quantities for development and will make prompt delivery on production parts in reasonable quantities. Call, wire or write General Ceramics Corporation, Keasbey, New Jersey. Please direct inquiries to Dept. E.

APPLICATION	DESIRED PROPERTIES	FREQUENCY	FERRAMIC BODY	SHAPES
Filter Inductors	High μQ, magnetic stability, sometimes adjustable	up to 200 kcs 200 kcs-10 mcs 10 mcs-80 mcs	"O-3", "T-1" "Q-1" "Q-2"	Cup cores, toroids, C-cores, E-cores, slugs
IF Transformers	Moderate Q, high μ, magnetic stability, adjustable	465 mcs 40 mcs other	"Q-1" "Q-2" Materials for filter inductors apply	Cup cores, threaded cores, toroids
Antennae Cores	Moderate Q, high μ, magnetic stability	.5-10 mcs 10-50 mcs	"Q-1" "Q-2"	Rods, flat strips
Wide Band Transformers	High μ, moderately low loss	1 kc-400 kcs 1 kc-1 mc 200 kcs-30 mcs 10 mcs-100 mcs	"O-3", "T-1" "H" "Q-1" "Q-2"	Cup cores, toroids, C-cores, E-cores
Adjustable Inductors	High μ, moderately low loss	Same as Wide Band Transformers	Same as Wide Band Transformers	Rods, threaded cores, tunable cup cores
Tuners	High μ, moderate to high Q, magnetic stability, as much as 10 to 1 adjustability with mechanical or biasing methods	Up to 100 mcs	For high Q selective circuits, materials under filter inductors apply. For others, materials under wide band transformers apply	Threaded cores or rods for mechanical tuning. Toroids, C-cores, E-cores for biasing methods
Pulse Transformers	High μ, low loss, high saturation	Pulse	Materials under wide band transformers apply	Cup cores, toroids, C-cores, E-cores
Recording Heads	High μ, low loss, high saturation, resistance to wear	Audio, pulse	"H" "O-3", "T-1"	

GENERAL CERAMICS

Industrial Ceramics for Industrial Progress...Since 1906

←CIRCLE 47 READERS SERVICE CARD

CIRCLE 48 READERS SERVICE CARD

TUNG-SOL POWER TRANSISTORS IMPROVED THREE WAYS BY:

NEW Cold-Weld SEAL

Tung-Sol's new true cold-weld seal represents a major advance in transistor technology. An exclusive Tung-Sol development, cold-weld sealing increases TO-3 outline package efficiency and brings designers a threefold bonus in over-all transistor performance.

Improved thermal qualities. The cold-weld process produces a hermetic, copper-to-copper seal and makes possible a 100% copper transistor with thermal properties superior to previous high power types.

Improved reliability. Cold-weld encapsulation eliminates heat damage, "splash", and heat-caused moisture that can impair transistor performance.

Longer efficient life. Even through temperature fluctuations that cause "breathing", the cold-weld seal stays vacuum-tight, moisture-proof—result of actual integration of the copper molecules during sealing.

Tung-Sol power switches with the new cold-weld seal withstand the most rigid combination of tests given any transistor—the 100 psi "bomb" immersion test and the critically sensitive Mass Spectrometer leak test. Further, they meet all military environmental requirements. For full data on the improved Tung-Sol types . . . to fill any transistor need, contact: Semiconductor Division, Tung-Sol Electric Inc., Newark 4, New Jersey.

THESE TUNG-SOL HIGH POWER (TO-3 OUTLINE) TRANSISTORS FEATURE THE NEW, COLD-WELD SEAL

Type	BV_{CES} (V_{BE} = +1.0v) Volts (Min)	BV_{CEO} (I_B = 0) Volts (Min)	h_{FE} (I_C = 1.0 A)	h_{FE} (I_C = 2.0 A)
2N378	−40	−20	50	30
2N379	−80	−40	50	30
2N380	−60	−30	70	50
2N459	−105	−60	50	30

TO-3

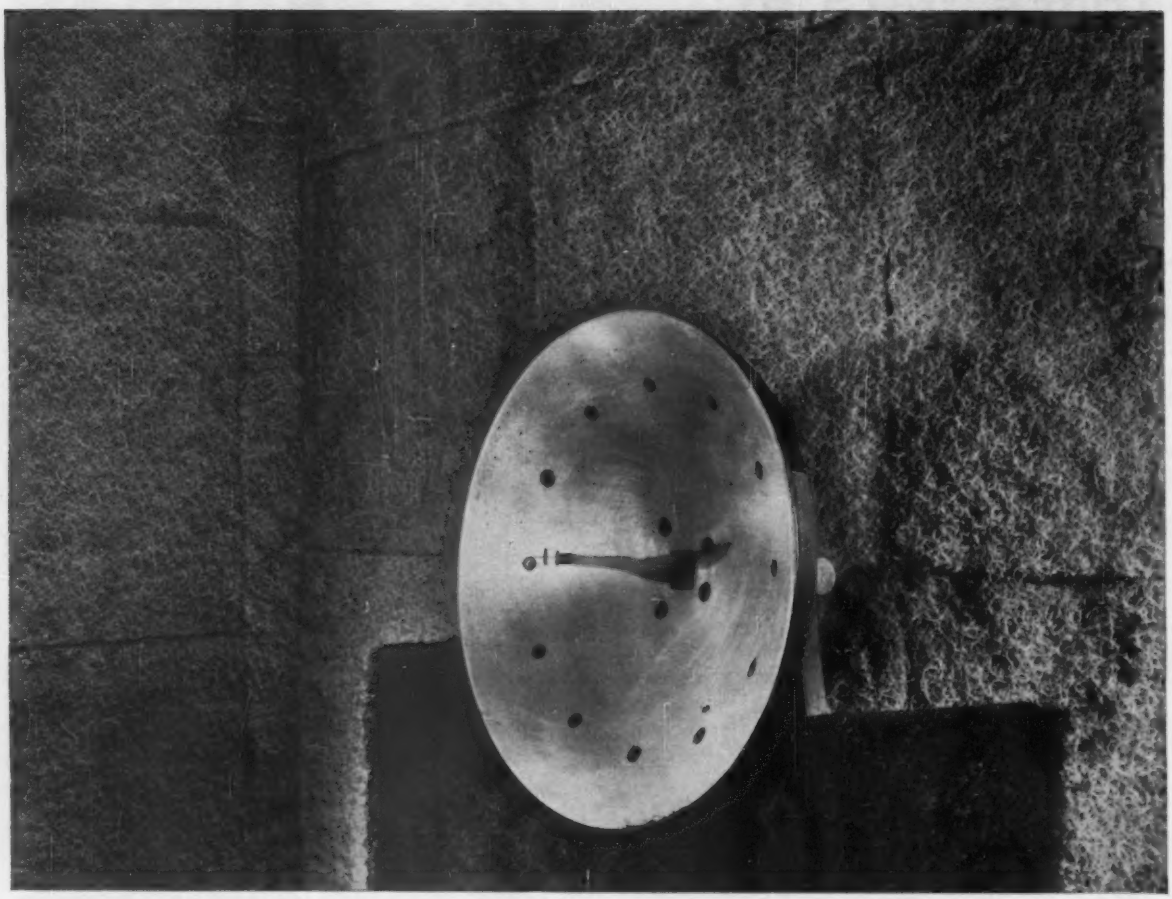
IMPROVED SPECIFICATIONS OF TUNG-SOL COLD-WELDED HIGH POWER TRANSISTORS.

Collector Dissipation @ 25°C*...50 Watts
Collector Dissipation @ 55°C*...25 Watts
Thermal Resistance.....1.2° C/Watt Max.
I_{CBO} @ V_{CB} = −25v T = 25°C...0.5 Ma Max.
I_{CBO} @ V_{CB} = −25v T = 85°C...7.5 Ma Max.
Storage Temperature.....−55 to +100°C

*Mounting base temperature

TUNG-SOL®

B.F.Goodrich



Best long range investment for indoor antenna testing and free space chambers

Manufactured to Military Specifications ... B. F. Goodrich Microwave Absorbents provide the most accurate reflection-free rooms for the measurement of microwave antenna patterns. As a result of thorough quality control and factory testing, B. F. Goodrich Microwave Absorbents consistently duplicate free space conditions indoors better than any other product.

In addition to outstanding electrical qualities, our absorber is light-weight, fire-retardant, easy to install. It will not deteriorate in performance when walked upon and has excellent water and weather resistant properties.

The material is currently being produced in a number of thicknesses providing broadband operation as low as 50 megacycles. Material can be furnished having less than 0.1% reflection at specific frequencies. For darkroom use, a special white compound can be applied to the surface of the pads to increase light reflectance.

When you're investing thousands, start right—specify B. F. Goodrich—the company with the *longest* experience and record for *consistently* high quality microwave material.

For new booklet on these absorbers write The B. F. Goodrich Company, 486 Derby Place, Shelton, Connecticut.

List of B. F. Goodrich Broadband Absorbers

Designation	Lowest Frequency*	Thickness	Maximum Reflection
12 CM	2500 mc	1½"-2"	2%
12 CM – 1%	2500 mc	1½"-2"	1%
12 CM – 30db	2500 mc	1½"-2"	0.1% at X-band. 2% elsewhere.
5 CM	5000 mc	1"	2%
30 CM	1000 mc	3½"-4"	2%
30 CM – 1%	1000 mc	3½"-4"	1%
60 CM	500 mc	7"-8"	2%
60 CM – 1%	500 mc	7"-8"	1%
100 CM	300 mc	10"-11"	2%
200 CM	150 mc	26"	2%
600 CM	50 mc	69"	2%
8 CM—glass fiber	3600 mc	1"-1½"	2%
4 CM—glass fiber	7500 mc	¾"	2%

Most of the above absorbers can be furnished with 0.1% maximum reflection at selected points in the frequency band.

*All perform up to 30,000 mc

B.F.Goodrich
microwave absorbents

high reliability . . . extreme compactness . . .

IN THE

NEW SANBORN 850

6- & 8-CHANNEL DIRECT WRITING SYSTEM

If you want a practical direct writing system for straight-forward recording in the range from DC to 100 cps — such as computer readout, telemetry recording — look what the new Sanborn "850" offers in compactness, reliability and operating convenience. A complete 8-preamplifier module with power supply, plus an 8-channel flush-front recorder package containing power amplifiers and power supply at rear, occupy only 24½" of "850" panel space.

PERFORMANCE characteristics of an "850" include flat frequency response 0–70 cps, down 3 db at 100 cps (10 div. peak-to-peak amplitude) . . . thermal drift eliminated by current feedback power amplifiers . . . limiting at input to prevent amplifier saturation or cut off, so that damping is never lost . . . drift less than 0.2 div. for 20° to 40° C. changes, line voltage changes from 103 to 127 volts . . . gain stability better than 1% with 20° C. and 20 volt changes . . . linearity 0.2 div. over 50 divisions . . . clear, permanent, inkless recordings in true rectangular coordinates.

IN RELIABILITY, "850" features include fully transistorized power amplifiers and power supply . . . rugged galvanometers with low impedance, high current, enclosed coil assemblies and velocity feedback damping . . . JAN components wherever practical, such as MIL-T-27 hermetically sealed power transformers, MIL-approved electrolytics in power supplies, etc. . . . forced filtered air cooling for stable operation.

And in operating **CONVENIENCE,** an "850" system provides such advantages as nine electrically controlled chart speeds, selected by pushbuttons . . . a choice of interchangeable Preamplifiers (DC Coupling and Phase Sensitive Demodulator presently available, with others in development) . . . remote control of chart drive, speeds, timer and marker . . . monitoring connection points . . . a Recorder that loads from front and has built-in paper take-up and paper footage indicator.

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- **FIELD-TESTED RELIABILITY**—uniquely balanced properties provide better thermal life.

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Nyleze* is another example of the advanced magnet wires developed by Phelps Dodge through its Applied Research. It is a new combination of materials with highly desirable properties for use in such applications as series armatures and fields, stators, potted coils, random wound coils, toroids and other difficult winding designs. These properties suggest possibilities for cost economies and improved designs that result in better operating performance of your equipment.

*Nyleze is red in color

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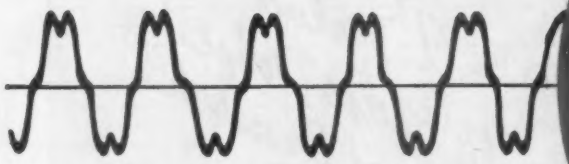
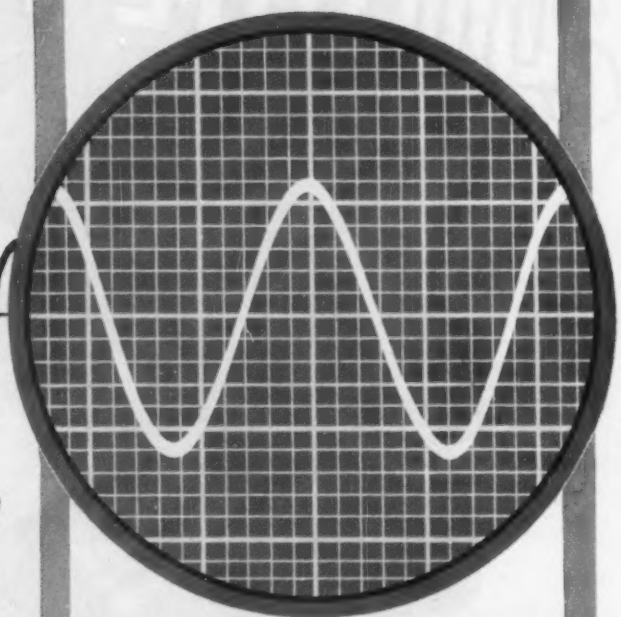
INCA MANUFACTURING DIVISION

FORT WAYNE, INDIANA

NEW 400 cycle DEVR

eliminates distortion





regulates voltage

Distortion Eliminating Voltage Regulator responds to transient surges and harmonics, as well as to normal variations caused by line and load changes. The Curtiss-Wright Model 104 DEVR corrects for any deviations of up to 20% from pure sine wave, regardless of their nature, in less than 125 microseconds.

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Write today for complete information. Price: $1875 f.o.b., Carlstadt, N. J.

The DEVR is also available in 60 cps model.

SIMULTANEOUSLY AVAILABLE

- **1.4 KVA** — regulation ±1% electronically; response 125 microseconds; distortion elimination to less than 0.3%
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ELECTRONICS DIVISION

CURTISS-WRIGHT

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PLAN '59

How Modern Is American Industry?

A Report by the McGraw-Hill Department of Economics

THE U.S.A. is starting a new period of economic growth, as we leave behind the recession of 1958. This new period presents a challenge to the nation, to the business community and above all to the individual company – to grow *at a profit.*

By now it is clear that growth is the normal way of life for the U.S. Economy. Since 1947, our national product has been growing at a rate of 3.7% a year. And no recession, even the latest and most publicized, has interrupted the trend for long. Now the economy is growing again.

But the conditions of growth are far different from those that prevailed in the years 1947 to 1957.

Today growth in the economy does not mean pressure on capacity, for most industrial firms. It does not mean easy profits. Rather, this is growth under highly competitive conditions, with profits dependent on a firm's ability to hold down costs. **Is our plant and equipment modern enough to do the job?**

A New Survey

To find the answers to this question, the McGraw-Hill Department of Economics has just completed a special survey of business needs for modernization. **The survey shows that it would cost $95 billion to replace today's obsolete equipment.** And this is a priority job, if business is to get costs down for the years ahead.

This tremendous need for modernization presents a challenge to the U.S.A. as a nation. The Communist powers are making a strong and disciplined effort to demonstrate that they can out-produce us – that they can "plow us under" in a contest of industrial strength.

It is a challenge to American business. Our people expect a continuously rising standard of living. Our workers expect wage increases. And often their demands mean price inflation – unless we can achieve sharp gains in output. The public demands higher national income without inflation. This is the challenge to business as a whole.

It is a challenge to the individual firm. Growth in the economy no longer means an automatic rise in sales and profits for any particular company. There are no shortages; industrial capacity is ample. So to participate in growth, the individual firm must achieve better quality or lower costs than its competitors. Otherwise, there will be no profit in growth and no success story for the company.

Is business prepared today for these challenges? The answer, from our study, is clearly "No". The production and distribution facilities of the U.S.A. are not efficient enough to ensure our continuing superiority over the Communist world, to match every wage increase with higher productivity, to do business in a competitive economy at satisfactory profit to the individual firm.

This statement sounds shocking at a time when much industrial capacity is idle and the recession just behind us is being blamed on a surplus of capital goods. But the facts speak for themselves. Here is the record on the past decade of investment in new plant and equipment, and here is our new study of the job that still remains to be done.

THE MODERNIZATION JOB AHEAD: $95 BILLION

The McGraw-Hill Department of Economics asked a wide sample of manufacturing companies, and experts in other industries, "What would be the cost to replace all obsolete facilities with the best new plant and equipment?" Here is a summary of the estimates. (Details on next page.)

MANUFACTURING AND MINING	$34.3 Billion
PETROLEUM INDUSTRY	5.3
TRANSPORTATION AND COMMUNICATIONS	18.4
ELECTRIC AND GAS UTILITIES	12.0
FINANCE, TRADE AND SERVICES	25.0
TOTAL: ALL BUSINESS	$95.0 Billion

Decade of Expansion[1]

Since 1947, private business in the U.S.A. has invested $291 billion in new plant and equipment. Our manufacturing capacity has increased about 80%; electric power capacity, 145%; capacity for basic raw mate-

[1] Figures on "Decade of Expansion" are for the years 1947-1957 inclusive, except where specific reference is made to preliminary data for 1958.

THE McGRAW-HILL SURVEY OF MODERNIZATION NEEDS

Conducted by the McGraw-Hill Department of Economics in August, 1958

INDUSTRY:	AGE OF MANUFACTURING CAPACITY Percent Installed: Prior to Dec. 1945	Dec. 1945 to Dec. 1950	Dec. 1950 to Dec. 1957	COST TO REPLACE OBSOLETE FACILITIES: Millions of $
Iron and Steel	47%	16%	37%	2,855
Nonferrous Metals	47	13	40	1,022
Machinery	41	21	38	3,224
Electrical Machinery	34	18	48	1,917
Autos, Trucks and Parts	42	11	47	2,204
Transportation Equipment (aircraft, ships, railroad equipment)	59	9	32	854
Other Metalworking	54	17	29	2,351
Chemicals	30	23	47	3,070
Paper and Pulp	49	17	34	2,655
Rubber	46	9	45	600
Stone, Clay and Glass	46	20	34	1,840
Petroleum Refining	45	26	29	1,499
Food and Beverages	58	19	23	3,443
Textiles	59	18	23	1,001
Misc. Manufacturing	51	21	28	6,236
ALL MANUFACTURING[1]	48	19	33	34,771

[1] Includes petroleum refinery companies listed under "petroleum industry" in previous table.

rials, by 55%. The distribution and service industries have increased floor space by roughly 50% in the decade. In 1957 alone, business spent $37 billion on new plants and equipment – more than the combined expenditure in all of Western Europe plus Canada.

But all of this expenditure has not made our facilities as modern as supposed, or as modern as we need. Of the $291 billion invested by business since 1947, roughly $157 billion has been for expansion of capacity. Only $134 billion has been spent to replace old facilities with better, more modern equipment. And in recent years, this investment has not purchased as much new equipment as the dollar figures suggest, because prices of capital goods have climbed.

Our postwar capital investment has repaired the worst of the obsolescence accumulated during the depression and war years. But huge amounts of old equipment are still in use, as shown by the table above. This is based on a survey of the age of manufacturing capacity in several hundred companies, representing all of the major manufacturing industries. Almost 50% of our present capacity was installed before or during World War II. More than 65% was installed before Korea. Expert studies of the major non-manufacturing industries show that the age of equipment, in those industries, is even greater.

Thus, of all business plant and equipment, less than one-third is modern in the sense of "new" since 1950; two-thirds is pre-Korea.

This over-all figure is confirmed by a check on specific industries:

- Nearly two-thirds of our metalworking equipment was installed over 10 years ago, according to preliminary results of AMERICAN MACHINIST's 1958 census.
- Over 65% of the freight cars on our railroads are more than 10 years old.
- Less than half the capacity to process chemicals, rubber or petroleum is new since 1950 – a period that has seen rapid development in such equipment as automatic controls for these process industries.

These examples take on a dollars-and-cents meaning when we recognize that the latest machine tools are about 40% more productive than 1948 models, and that a combination of new freight cars and modern freight yard equipment can reduce operating costs up to 50%. New instruments, that automatically direct the flow of a chemical (or other raw material) process, can often reduce processing costs enough to pay back the cost of the instruments in one year. These savings cannot be made in older plants. By using obsolete facilities, our industries accept a waste in labor and materials that totals many billions of dollars per year.

Why Productivity Must Rise

The U.S.A. can ill afford this waste. In the economic struggle between the free world and Communist world, our margin of superiority depends on the efficiency of our productive facilities.

For the growth of our own economy, we shall need a sharp rise in productive efficiency. During the next ten years, American business must provide the goods and services required for a population that will increase by 32 million. And the increased population will expect higher living standards. Furthermore, the population in ten years will include a higher proportion of dependent persons – children and retired people – and a smaller proportion of working age men. Thus, with a relatively smaller labor force, industry must provide more goods for more consumers.

At the same time, industry must strive to hold the line against rising costs. In an economy with a tight

labor supply, we cannot count on restraint in wage demands, however desirable such a development might be. In the past ten years, hourly wage rates have increased over 5% per year, nearly twice as fast as output per manhour. And this disparity may well continue – causing still more inflation–unless we make more rapid gains in productivity.

We can make these rapid gains – if industry goes all out to modernize its equipment. Output per manhour (in manufacturing) has increased only 2.5% per year since 1951. But this compares with gains of 4% a year in 1947-1950, and over 5% in the 1920s. Today the machines and techniques are available for us to equal, or exceed, these records – to raise output per manhour at least 5% per year. This is a job that can, and indeed must be done, to assure growth in the economy without inflation.

The Job Ahead

The dimensions of this opportunity are shown by the table on the previous page. In its survey on the need for modernization, the McGraw-Hill Department of Economics asked a wide sample of manufacturing companies how much it would cost to replace *all* their out-dated facilities with the best new equipment available. The Department also interviewed experts in each of the non-manufacturing industries, to find answers to this question. The answers add up to a staggering bill for new plant and equipment.

Modernization of over-age facilities – replacing only what is really obsolete, by today's production standards – would require a total capital investment of $95 billion, or nearly $20 billion per year for the next 5 years.

Furthermore, new production techniques will soon make *today's* plants obsolete, in many cases. Thus, to keep pace with technical advance *from 1958 on*, will require continuing expenditures of $8 to $10 billion per year for modernization.[1]

The total expenditure to wipe out the backlog of obsolete facilities, and keep up with continuing technical advance between now and 1963, would be at least $135 billion.

The U.S.A. has never spent such a sum on the modernization of industrial facilities. Capital expenditures of boom dimension have, in the past, been associated only with the urgent expansion of capacity. **Some forecasters are now saying that because industrial capacity is adequate, the next few years will be a period of low capital investment. The figures above make clear that this would be a national calamity.** The opportunity is there–and the challenge–to invest record amounts of capital in the modernization of plant and equipment.

A National Problem

This also is a challenge to the U.S.A. as a nation. For 100 years, this nation has been looked to as the model of economic development by the rest of the world. For the first time, we face a serious challenge by another nation and another economic system that claims to be better. In a carefully documented 111 page study released in May, the U.S. State Department declared that "the most serious threat" to the U.S.A. today is the drive for economic supremacy by the Soviet Union.[2] Although a much smaller nation industrially than the U.S.A., the U.S.S.R. is today increasing its national output at a rate of 7% per year and its output per manhour by 4% per year.

The U.S.A. does not have to match these specific figures, which represent the results of forced labor in a country just starting to develop industrially. In the contest to win uncommitted nations, the statistics are not likely to be quoted exactly, in any case. But our over-all growth in national output and living standards must be so impressive as to leave no question of superiority. Our factories must be showplaces of modernization to the foreign visitor that will leave him unable to say "I saw much better" in Britain, or West Germany, or Russia.

This is the challenge to the nation –a political challenge to be sure. But it coincides with the challenge to the business community and the individual firm. And the way to meet it is the same: by thorough and rapid modernization of our plant and equipment – not by the slow and steady pace of recent years, but at an accelerated rate that reflects the greater pressure for output at lower cost.

Obstacles To Be Overcome

We must face up to the fact that real obstacles – both technical and financial–stand in the way of faster modernization. Some companies do not have the technical "know-how" required for the latest production techniques. Many more lack the financial resources. How can we overcome such obstacles, and speed up the replacement of old facilities?

In the course of its study, the Department of Economics obtained comments on these questions from many executives. One of the problems, as we noted above, has been the urgent pressure to expand capacity during most of the postwar period. In giving their attention to this problem, companies have sometimes overlooked the chance to modernize older plants.

In some cases, equipment has been kept in place because it was satisfactory, and the users were not aware of still newer designs. Some equipment users believe that equipment makers are not sufficiently aggressive in designing and demonstrating new models.

The biggest obstacle – and one that presents a persistent problem – is the shortage of funds in many companies that need and want to modernize. For all corporations, the cash flow from retained earnings and depreciation has increased by more than $5 billion from 1953 to 1958. But a number of key indus-

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[1] This estimate is based on technical developments reported by McGraw-Hill editors and current price trends for capital goods. It is consistent with the plans for modernization expenditures in 1958-61 reported by companies in a McGraw-Hill survey conducted in April, 1958.

[2] "The Sino-Soviet Economic Offensive in the Less Developed Countries" – U.S. Department of State, May, 1958.

MODERNIZATION PAYS

Profits on modernization—like all business profits—have come down since 1955. However, modernization, in contrast to new capacity, still offers a relatively quick return on investment. Here are companies' answers to the question: "In cases where you are actually replacing old facilities with new plant and equipment in 1958—how soon do you expect these replacement expenditures to pay off?"

	PERCENT OF COMPANIES ANSWERING			
INDUSTRY:	1 to 2 yrs.	3 to 5 yrs.	6 to 8 yrs.	9 yrs. and over
Iron and Steel	11%	56%	11%	22%
Nonferrous Metals	29	71	0	0
Machinery	12	56	12	20
Electrical Machinery	29	57	7	7
Autos, Trucks and Parts	40	60	0	0
Transportation Equipment (aircraft, ships, railroad equipment)	7	53	20	20
Other Metalworking	38	33	10	19
Chemicals	10	53	21	16
Paper and Pulp	22	22	22	34
Rubber	33	33	34	0
Stone, Clay and Glass	0	57	36	7
Petroleum Refining	16	50	17	17
Food and Beverages	16	44	12	28
Textiles	37	47	5	11
Misc. Manufacturing	9	52	13	26
ALL MANUFACTURING*	18	50	14	18

**Note:* Answers to a similar question, in a 1955 McGraw-Hill survey, were as follows: 1-2 years: 17%, 3-5 years: 64%, 6-8 years: 11%, 9 years or more: 8%.

tries have failed to keep pace with the general trend. **These include some of the areas where the need for modernization is most urgent: the railroads, large sections of the textile industry, some mining industries and many small to medium-size companies in manufacturing generally.** The problem of these industries and companies has grown more acute in 1958 – since their profits have declined much more than the average for all business.

Any plan to step up the pace of modernization generally must deal with the special situation in these problem areas. Depressed industries and companies need outside help, if they are to modernize. Such help would include a stronger flow of technical information and advice (and occasionally, venture capital) from the more prosperous, inventive industries – as well as advice from equipment suppliers and distributors, industrial publishers and consultants. There is also a public responsibility to help in the problem areas—not with handouts of government money, but with technical assistance and help in finding private capital (like the efforts now being pursued by the Small Business Administration).

Certainly we should lose no time in reforming those provisions of the federal tax laws that now impede investment in modern equipment by hard-pressed firms – especially the outmoded and unfair restrictions on rates of depreciation for tax purposes. At present, the tax regulations require that depreciation be computed over relatively long periods of "useful life" for most types of equipment. And this is a primary reason for the lag in modernization. Machinery generally becomes obsolete long before the expiration of its "useful life" as specified in tax regulations. But it is difficult for companies – especially small companies – to set aside cash for rapid replacement, unless the full amount to be set aside is exempt from income tax. Canada and most European nations allow more rapid depreciation for tax purposes than does the United States.

A combination of self-help with technical help, and a fair break from the tax laws, would do much to reverse the spreading tide of obsolescence in depressed industries, and in many small companies.

PLAN '59

It is this combination that McGraw-Hill advocates as "PLAN '59", to help business modernize *now* for growth and profits. This is what it will take to make a start in 1959 on the $95 billion job of modernization, disclosed by the study we have just completed:

1. A better flow of technical information on where and how to modernize business plants and equipment.

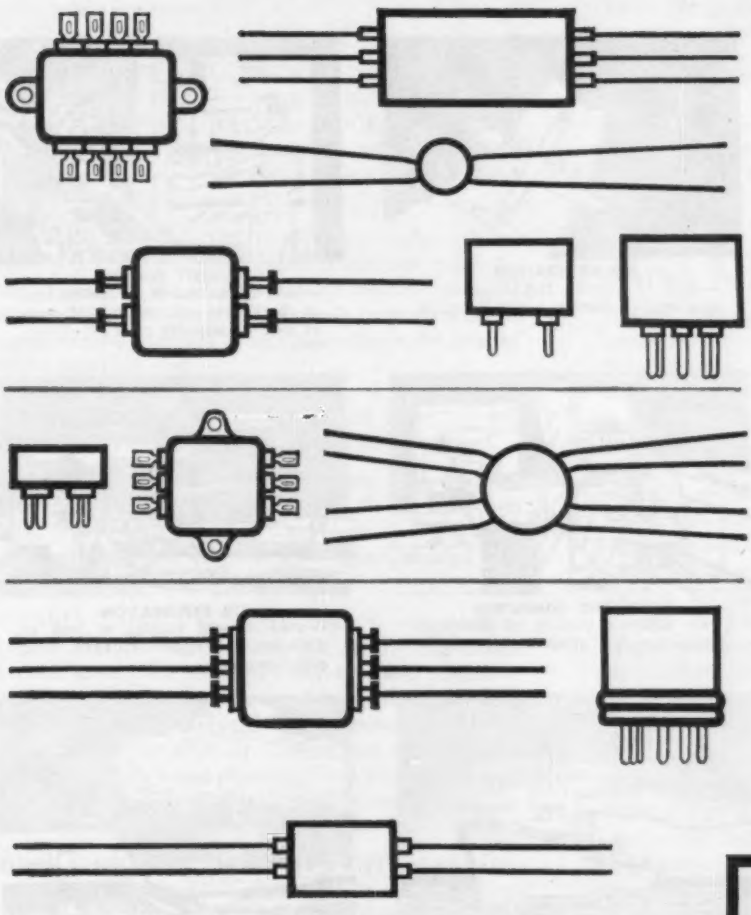
2. Careful review by the individual company of its own opportunities to modernize at a profit – then action to replace obsolete facilities.

3. Reform of the tax laws, to allow more realistic deductions for depreciation, and permit more companies to finance adequate modernization programs from this source of funds.

Much of this program is already underway. The 34 McGraw-Hill Publications, and many suppliers and distributors of industrial equipment, have stepped up their information programs to start the modernization drive. Preliminary plans of manufacturing companies show a strong emphasis on capital spending for this purpose. In August, Congress passed a bill providing limited tax relief for small business.

But the real task of modernization still lies ahead. It is the greatest challenge, and the greatest opportunity, confronting American business as we move forward into 1959.

PULSE TRANSFORMERS



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For complete engineering data and application information on pulse transformers, switching transformers, and magnetic shift registers, write the Technical Literature Section, Sprague Electric Company, 35 Marshall St., North Adams, Massachusetts.

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TI's Applications Engineering Department invites your requests for technical assistance in OEM or end uses. Here are a few of the present applications.

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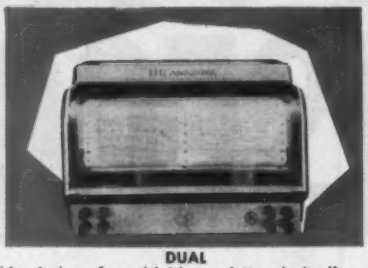
Rectilinear Galvanometric Recorders, with a wide choice of sensitivities and "recti/riter" accessories, offer the most complete ranges available for recording electrical parameters from many types of transducers.



MISSILE TESTING
—a bank of "recti/riter" units record voltage frequencies and currents.

MEDICAL RESEARCH
—used with rate meters and nuclear scanners . . . also used to monitor rate of impurities in vaccines.

AIR NAVIGATION
—used to monitor ILS beams . . . also used to monitor LORAN signals.

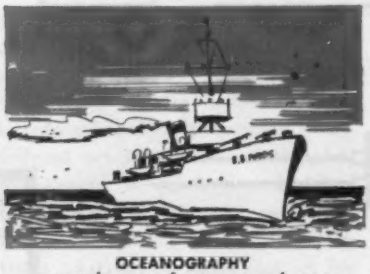
QUALITY CONTROL
—used on numerous production lines to check sizes and contours of parts, as well as assembly rates.

METEOROLOGICAL
—records wind directions and velocities . . . also used in studies of Aurora and air glow through scintillometer counters.

AUTOMATIC COMPUTERS
—for studying stability of electrical parameters that affect accuracy.

OIL EXPLORATION
—used in well logging as well as airborne magnetometers and scintillometers.

RADAR SPEED METERS
—used in police vehicles to visually record speed of passing motorists.



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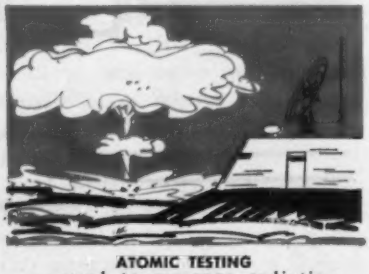

ATOMIC TESTING
— used to measure radiation fall-out at test centers and nuclear installations.

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electronics
engineering issue

OCTOBER 24, 1958

CROSS PLAN '59 TALK

THE YEAR 1959 is the time for American industry to modernize its facilities in preparation for what economists predict will be a decade of tremendous opportunity.

CONSUMER GOODS—The major impetus behind a boom foreseen for the 1960's will be an augmented demand for consumer durables as young people born during World War II marry and form new families. Increased spending for consumer durables will mean more sales of television sets; radios; phonographs and high-fidelity equipment.

INDUSTRIAL ELECTRONICS—The boom will extend to all parts of the consumer durable field. As the hard-goods industries strain to satisfy increased demand they will turn to electronic instrumentation and control equipment to increase output and quality while reducing cost.

The increased level of economic activity should stimulate the process industries, and these too will become better customers for electronic equipment.

MILITARY PRODUCTS—Industry can expect spending for defense to remain at its present high level or to creep upward. The trend towards more complex space-age weapons will help electronics take a larger share of military spending.

PRODUCTION—The place to begin is with production facilities. In the last six years significant strides have been made in automatic and semiautomatic production equipment for wiring, assembly soldering and testing. New materials and components such as modular and printed circuits have been refined to make possible great savings in time and money. Nevertheless, much electronic equipment is still assembled as it was in the late 1920's.

RESEARCH AND DEVELOPMENT—Modernization of facilities cannot stop at the production line. Nor does modernization stop with the installation of the latest and most precise test and measurement equipment in the laboratory.

In preparing for the challenge of the years to come creative power must be given every possible assistance. Instruments that give the desired parameter values directly and in the most easily used form are needed to conserve valuable engineering time. Similarly needed is more electronic computation and data processing equipment.

Industry will also find it necessary to render even more assistance to colleges and universities in money, equipment and part-time teaching talent. Modernizing our educational facilities is indeed part of any successful modernization program in an industry that depends so much on scientific advancement.

MARKETING—There is a big job to be done in distribution and marketing. Experience has taught the futility of haphazard market research.

Professional staffs will have to be organized and trained to insure that development time is concentrated on products for which there is a real need and ready market.

WAYS AND MEANS—All these and many other programs are of greatest urgency before the next boom begins. But can the electronics industry pay for modernization now?

The electronics industry is in an enviable position to raise money at this time. Firms in our industry have an outstandingly good record both in selling common stock and in borrowing money through devices such as convertible debentures. Institutional investors seem to favor electronics. Many firms have united with older companies of other fields, more skilled in marketing and distribution, through merger or joint ownership of subsidiary corporations. Military producers have frequently found the government helpful in providing both money and equipment.

MODERNIZE NOW—It is likely that our industry will double its output of goods and services within the next five years. For many business organizations 1959 will be a year of decision. Management cannot stand still, satisfied with just a share of the existing market. It is not unusual for a manufacturer to point out that 80 percent of sales today are derived from products that did not exist commercially 15 years ago.

The future in this industry, as in American industry as a whole, belongs to those firms whose facilities are geared to make the best possible products at the lowest possible cost; whose research and development activities are in close touch with the latest developments of the physical sciences; and whose managements are streamlined to get the job done with the minimum of wasted or duplicated effort.

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Electrically, they give you the superior dependability and life characteristics of our TAP series, in an extended range of capacities as shown in the chart. They have an operating range of −55°C to +85°C—offer excellent shelf life even when subjected to long periods of idle storage. Mallory TAP2 capacitors will pass the 2000 cycle/20G MIL-C-3965B vibration requirements for military applications.

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Standard Ratings for TAP2

140 mfd— 6 VDC	40 mfd—30 VDC	20 mfd—60 VDC
100 mfd—10 VDC	30 mfd—40 VDC	15 mfd—75 VDC
70 mfd—14 VDC	25 mfd—50 VDC	11 mfd—90 VDC

(standard capacity tolerance . . . −15% +75%)

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PRODUCTION MACHINERY for the Electronics Industry

By GEORGE SIDERIS, Associate Editor

Increasing use of machinery in the electronics industry is shown in view of Hewlett-Packard's tool room

- MODERNIZING MACHINERY AND TOOLS
- STREAMLINING PLANT LAYOUT
- ADVANCES IN COMPONENT PRODUCTION
- MECHANIZING EQUIPMENT ASSEMBLY

DURING THE PAST YEAR, the electronics industry again demonstrated its unique potential for continued growth by scoring a five-percent increase in sales volume (ELECTRONICS, p 13, Aug. 22). The increase was obtained despite a temporary setback in the national economy and increasing price competition within the industry.

Grasping the opportunities for profit that still lie ahead requires each electronic manufacturer to look to the adequacy of his production facilities. If the electrical machinery industry, which includes electronics, were to replace all its obsolete production facilities, the job would cost nearly $2 billion. And much of this replacement must be done.

According to the McGraw-Hill Department of Economics, hourly wage rates in the United States are increasing by more than five percent a year, twice as fast as the amount of hourly productivity per man.

A survey by ELECTRONICS of representative electronics plants shows that their owners are generally aggressive in developing and marketing improved products. The average manufacturer is inclined, however, to hew as closely as possible to the familiar production methods. But it has become a truism in our competitive economy that the firms who keep abreast of the best production methods stay out in front. Therefore, the pressure is on to bring our production facilities up to date.

Those firms which have carefully planned production modernization and pursue it diligently, find that it pays and is consistent with flexibility required by our industry. Specific benefits include increased quality at lower cost, more efficient utilization of plant space, faster deliveries and reduction of in-process inventories.

Machine tools have gained 40 percent in efficiency in the past 10 years. New machinery combines high speed with precision. Numerically controlled machines with simple two-axis positioning systems, versatile punch and drill presses speed production

PLAN '59

MODERNIZING MACHINERY and TOOLS

ELECTRONICS manufacturers require machine shops for product development, fabrication of jigs, fixtures and production machinery, and for production of housings, chassis, mechanical parts and components.

In-plant machine shops also speed up model building, back up vendors when orders are pressing and enable direct control over production schedules and quality.

Management practices vary. The shop may be an integral part of the production setup. It may be held in reserve for development and tooling work. It may bid competitively with vendors for the plant's business. Some plants have two shops: one group for model and pilot production, another for long-run production. For example, Telecomputing Corporation's divisions will have communal manufacturing machine shops at the firm's new plant.

A rule-of-thumb for job-shop management is to have perhaps one-fifth of machines idle during an average day. This avoids troublesome delays. Many companies also prefer to assign each toolmaker his own lathe.

There are no rules of thumb on the number of machine tools per company employee. In 20 representative electronics plants with a total of 11,725 employees there are 2,025 cutting and forming machines. The average ratio is 1:5.8, or one machine tool to every 5.8 workers, but the actual ratios vary from 1:13 in a military systems plant to 1:1.5 in an antenna and metallic components plant.

WHEN TO BUY–The latest machine tools are, on the average, 40 percent more productive than those of 10 years ago. They can take advantage of improved cutting tools, coolants and controls. The efficiencies of older machines can be stepped up, however, with new accessories such as automatic gaging, feeding mechanisms and attachments like magnetic chucks.

In all but a few of the plants visited, the majority of the machine tools are less than 10 years old. This is partially due to growth and partly due to a need for improved performance.

Automatic Electric cites a recent purchase of a six-station rotary indexing miller. It will replace nine millers for finishing switch castings. The new machine will reduce production lead time, reduce work-in-process inventory and cut floor space used from 1,500 to 400 square feet.

Eastern Precision Resistor purchased a diamond grinder to machine mica-filled epoxy bobbins. The material is highly abrasive, which hampered normal machining. Performance is considered three times as good as a screw machine's.

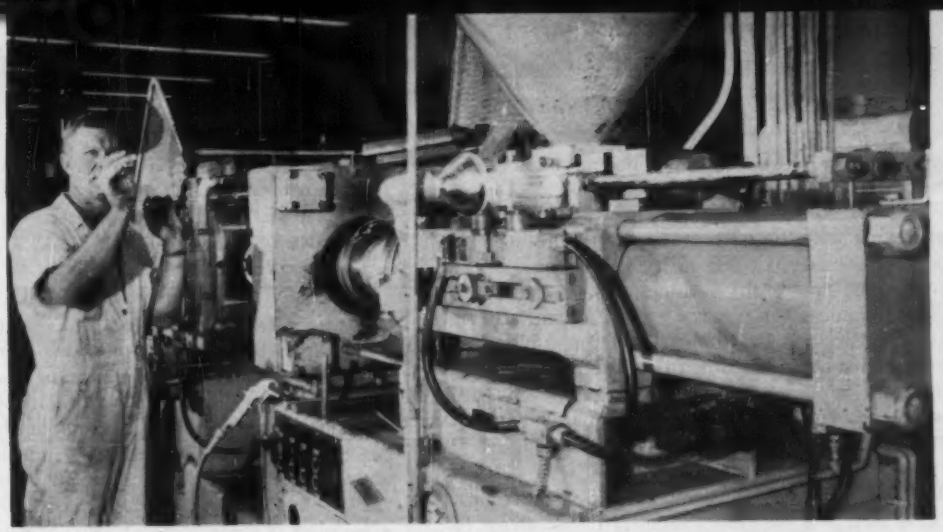
Ford Instrument is using a double-disk grinder to surface-finish plates formerly milled. The workpiece oscillates between the disks, giving an excellent finish. Speed is several times that possible with a miller. A stamping press was mechanized with a feed reel by having the strip metal supplier join the strips into coils.

Many firms, however, find production speed a secondary requirement to their machinery's precision. Periodic charting of each machine's ability to hold tolerances in varying materials and dimensions will determine machine capabilities. A guidance systems plant gives its quality-control section initial responsibility for tool selection.

NUMERICAL CONTROL–Numerical control has so far been confined to isolated plants in the electronics and other industries. It is being effectively applied to drills, cutoff machines, jig borers and other machine tools which can be operated in two axes. Positioning systems suitable for drills and punch presses can be had for under $10,000.

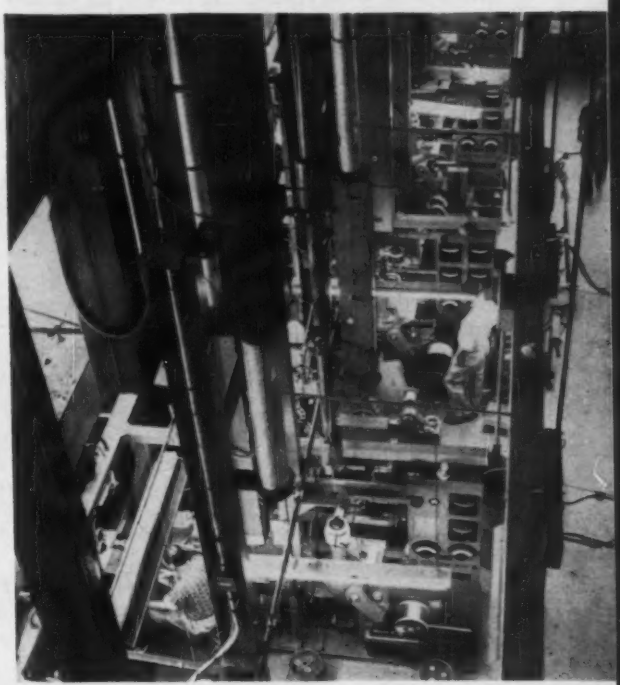
The grid layout commonly used for printed circuits avoids necessity for high-cost computer-directors often associated with numerical control. Two-axis programming can be quickly worked out on tape, cards and other material.

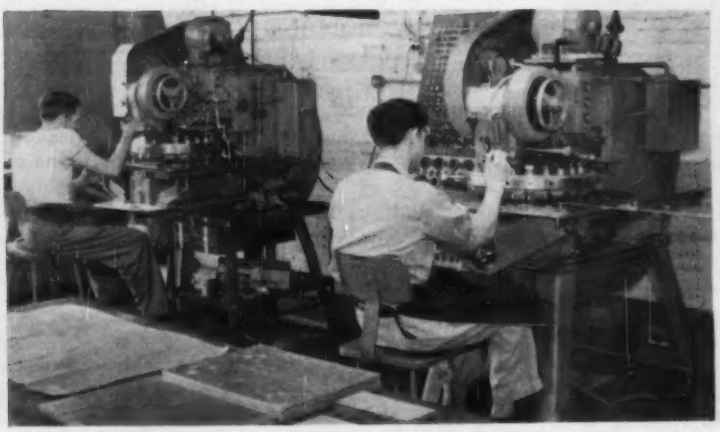
The advantage of programmed machine tools is that the program, once prepared, can be used again later without lengthy set-up time. The programs are pre-



Injection molding press turns out filter for oscilloscope, other parts at Hewlett-Packard

Machinist at W. L. Maxson finishes computer casting on jig borer





Powerful rams of precision extruders force Teflon jackets on wire at Hitemp Wires

Turret punch presses in action at Laboratory for Electronics

pared, in many cases, away from the machine so that downtime is at a minimum.

Electralab, for example, is using a numerically controlled drill, with four heads, for board drilling. The machine's accuracy is 0.001 inch and its rate is 60 per minute. The firm is also considering numerically controlled equipment for eyeletting, piercing and artwork.

General Electric's light military electronics plant uses a programmed cutoff machine to prepare tubular frames. It has also applied programming to punch and drill presses. The plant, which specializes in low-volume production, designs parts to a standard dimension system.

SPECIAL MACHINES–A number of machines particularly suited to electronics industry requirements for versatility have been on the market in recent years.

Best known are the punch presses for printed circuit and chassis work. Among the fast-change features are turret tool-changers and template operation. Radiation Counter Labs estimates it mechanized 10 percent of its production by switching from hand to semiautomatic chassis punching.

Drill presses are also operated with templates or photoelectric scanning. At least one shear manufacturer supplies a table with holes drilled to accept a variety of cutting guides.

Electrical discharge machines (see p 90) are now being used to carve out odd-shaped cavities without elaborate tooling. The electrode is prepared in the shape of the hole desired. Others use an electrode for rough machining and an ultrasonic grinder for finishing.

Complex bending operations, such as that required for waveguide plumbing (p 88), can be accomplished with special mandrel tooling on conventional bending machines. Meridian Metalcraft, however, found it necessary recently to make a bending machine because none on the market were satisfactory for its special requirements. Conical shapes, disk antennas and metal housings, can be flow-turned without material waste.

Epoxy-metal combinations can be used to make punches and dies for cases and other drawn parts. The plastic tools require only a few hours of work to prepare, plus curing time, after plaster, wood or metal molds have been prepared.

ULTRASONICS–The electronics industry is one of its own best customers in ultrasonics. Ultrasonic baths degrease and clean small parts and assemblies. Cavitation drives cleaning fluid between nested parts and into crevices, while the explosive action of the cavitation knocks off contaminants.

Another use is impact grinding of semiconductors, quartz crystal and other brittle materials. With honeycomb cutting heads, many blanks may be cut from a wafer at one time. Ultrasonically agitated plates will tamp down powdered material, such as carbon. Aluminum may be soldered or cold-welded with ultrasonics.

A basic mechanization technique at Gulton Industries is self-cleaning conveyors. This permits batch-type preparation of materials without cross-contamination. Fixtures which hold ceramic parts in a conveyorized plating line pass through an ultrasonic bath before reloading. Cavitation keeps plating from building up on the fixtures preventing hazard of shutdown.

Batches of small parts can also be cleaned in a common tank. Each batch is placed in its own cleaning solution in a beaker.

BRAZING, WELDING AND SOLDERING–Brazing and soldering of metallic components, such as waveguides and cavities, are mechanized in many plants by the use of preforms and induction heating.

Induction heating is particularly suited to regular shapes, since coil forms are simplified. Coils mounted on standard holders adapt an induction heating unit to many different workpieces in rapid succession.

Complicated shapes can be assembled with preforms in place of spring-loaded fixtures and dipped in a molten salt bath, for brazing, or in oil, for soldering. Dip brazing, according to W. L. Maxson Co., reduces brazing time from hours to minutes after jigging.

Western Electric uses a type of resistance welding, which it calls percussive welding. The welding head is built into a programmed terminal wiring machine. As wire is cut to length, a clipper tapers the end. The tapered point is held against the terminal and energized. The wire melts down and is held into its pool of molten copper or aluminum until it cools to a bond stronger than the wire.

Resistance soldering irons fitted with long, bent electrodes reach into places inaccessible to solid-tip soldering irons. The tips can also be placed on either side of hollow-pin connectors to insure that the solder fills the pin without voids.

FINE FINISHING–Cost of deburring, cleaning, drying or shaping batches of small parts can be reduced by barrel tumbling. A back-and-forth sliding action of the barrel protects fragile parts.

Westinghouse's electronic tube division plant tumbles also to achieve results difficult to get by hand methods. Tumbling produces rounded corners without tool marks, removes fine dust from carbonized metal, quickly unnests stampings.

Fine-line stripping of coatings and platings from windings, crystals and similar parts is accomplished by a commercial machine which spews a thin stream of a mildly abrasive dust.

PLASTIC MOLDING–Potted circuits or components free of voids are increasingly in demand. Modern commercial equipment will pour and degas the potting compound under vacuum.

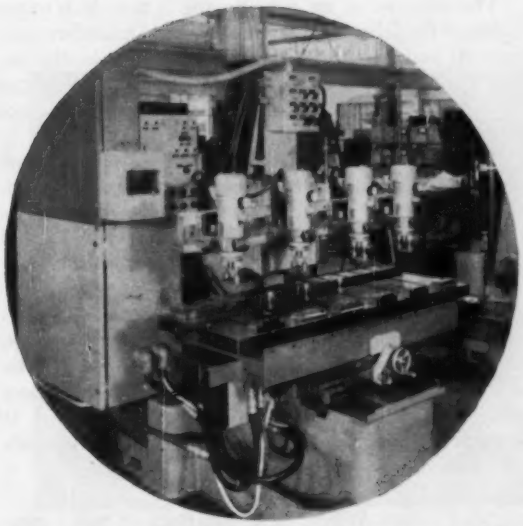
Another technique is to stack the potted parts, while warm in a barrel-like centrifuge. The open end of the molds face in. As the barrel whirls, the weight of the compound forces out air bubbles.

Where the length of the production run warrants die fabrication, pressure molding machines are effective and fast. Molding machines can be purchased in bench models and to take charges weighing as little as a quarter-ounce.

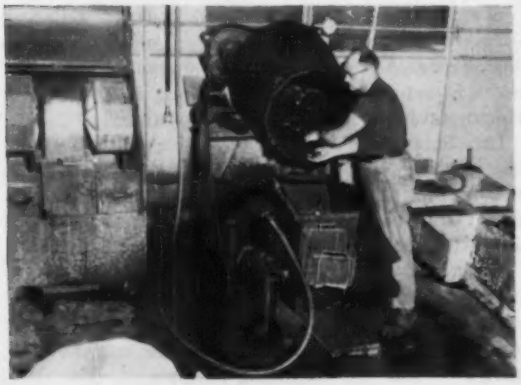
Machines are available which will meter out resin and hardener at the point of use. Batches do not have to be prepared beforehand, avoiding waste and rush.

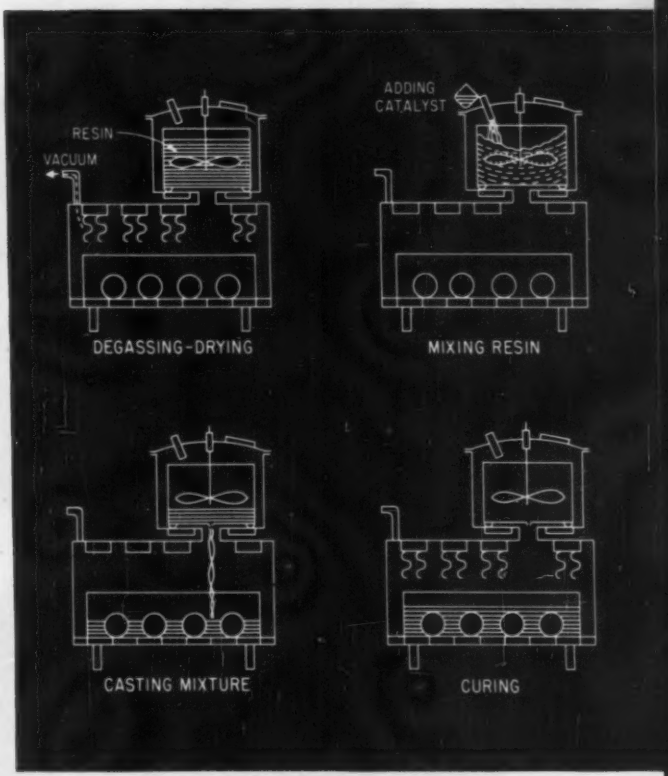
TABLE I—Obsolescence of Production Machinery in the Electronics Industry
(a study of 12 representative plants)

FIRM	EQUIPT. INVENTORY ($000)	AGE OF MACHINERY PERCENTAGE			HOW MACHINERY WAS PURCHASED			MAJOR PRODUCTION EQUIPMENT										
		% Over 10 Yrs.	% 5 to 10 Yrs.	% 0-5 Yrs.	% Off-the shelf	% Custom Made	No. of Emp.	Welders Heaters	Lathes etc.	Borers Shapers Millers	Power Brakes	Shears	Punch Presses	Drills etc.	Saws	Ovens	Grinders	Winders
Manufacturers of Commercial Equipment																		
A	1,500	60	40		90	10	775	7	16	11	3	2	15	42	4	1	2	26
B	800	10	—	90	70	30	300	4	10	3	9	—	—	14	—	21	—	48
C	—	—	30	70	100	—	700	5	25	17	—	—	12	17	11	8	8	4
D	50	—	20	80	100	—	150	—	1	1	2	2	3	5	1	—	2	5
Manufacturers of Military Products																		
P	430	10	80	10	80	20	1,300	11	27	22	6	5	23	70	9	9	12	18
Q	1,350	10	45	45	95	5	825	1	16	32	2	2	8	18	—	3	7	6
R	1,003	20	45	35	95	5	1,100	4	15	12	11	4	6	20	9	16	4	25
S	2,000	50	30	20	100	—	800	—	85	51	—	—	—	91	—	—	58	—
Manufacturers of Components																		
W	2,000	—	5	95	90	10	700	37	10	6	1	—	—	7	—	13	—	1
X		90	—	10	90	10	1,000	210	58	6	—	—	25	12	2	55	2	—
Y	250	—	10	90	65	35	130		7	2	1	1	6	7	12	28	9	2
Z	150	—	50	50	85	15	220		2	2	—	—	—	1	2	3	2	50



Four-station numerical drilling machine used by Electralab is controlled by four-inch Mylar tape





Vacuum is maintained throughout entire potting operation in Hull-Standard machine

After parts are unloaded from Westinghouse tumbling machine, load is screened to separate parts from media

Setting up product-centered group and workshops within one plant creates flexibility, allows supervisors and employees to work in closer harmony. Modular buildings with liberal access to utilities keep factory responsive to shifts in product demand

PLAN '59

STREAMLINING PLANT LAYOUT

DECENTRALIZING production operations in one plant can bring the same advantages, on a smaller scale, as setting up a subsidiary company to produce a specific product or class of products. In plants which are approaching an unwieldly size, decentralizing streamlines management and gives employees greater interest in their work.

Hewlett-Packard's new plant is product-centered rather than process centered. The plant is set up in groups responsible for producing a class of instruments, from prefabricating to final testing. The arrangement provides better supervision and avoids the problems which arise when subassemblers never see the final product.

Varian Associates has one machine shop for its tube engineering staff. The firm also provides each tube development laboratory with a staff machinist, who works in close cooperation with the engineer.

A number of assembly benches at Westinghouse tube plant have sufficient equipment to make a number of specialty tubes. Small-lot production is handled without interrupting the plant's main streams.

Bomac assigns product development and special production runs to a group of production employees with extra skill. Technology Instrument Corp. set aside a separate area for metallized component production. Texas Instruments' semiconductor components division plant management is decentralized into product departments to cope better with automation advances.

PLANT SERVICES–TI's plant was built with swift realignment of production lines in mind.

Some 38 utilities are run through a space frame between the two floors. Conduits for gases, various voltages, water, air, vacuum and waste extend up to the manufacturing floor and down to the engineering laboratories. There are about 3,000 such utilities access holes in the plant, spaced 10.5 feet apart. Access doors are spaced along exterior walls to facilitate movement of heavy equipment.

Air conditioning is a characteristic of new electronics plants. It is a requirement for some precision production and testing, or to eliminate noxious odors. In several plants observed, air conditioning was provided in noncritical areas as well in order to avoid ill-feeling among employees.

The ultimate in air conditioning is the clean rooms required for gaging and assembling high reliability components and systems. Psychological problems–the isolation of the rooms creates an other-wordly feeling–can be avoided by windows, lighting and ceilings designed to give a feeling of space.

A new clean area at Kearfott measures 4,000 square feet. In addition to constantly changing sterile air, the air varies in pressure from room to room. The highest pressure is in the final assembly area, so that possible contaminants flow toward the exit room.

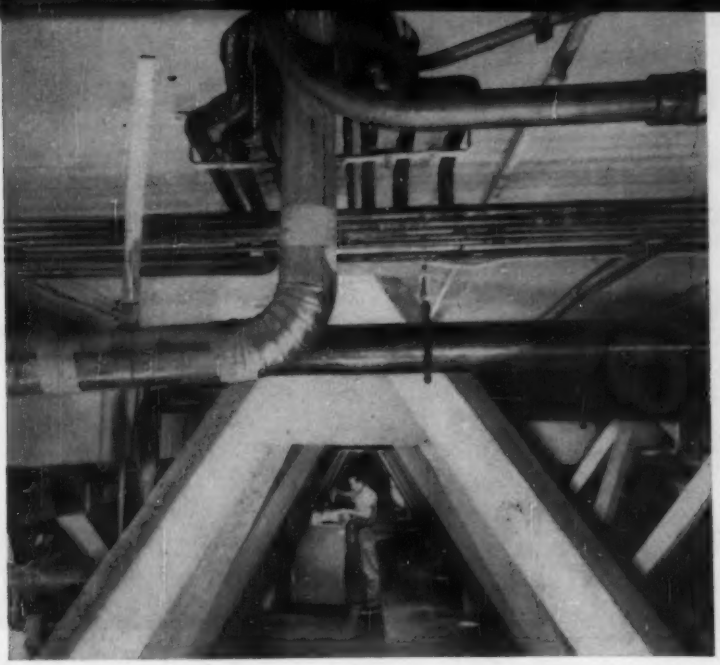
Most plants have compressed-air sources at strategic points. The air is used to operate and feed small parts to bench and hand tools, to drive assembly machinery, for drying, painting, cleaning and chemical tank agitation. Universal Atomics spot checks instrument cases by connecting an air hose and immersing the case. It is as effective as a prolonged seepage test and takes only a few seconds.

CONVEYORS–Where large quantities of bulky components and subassemblies must be moved, conveyors are the logical answer. There are several alternatives when power conveyors are not practical.

Skate conveyors can be used in place of a line of assembly benches. In a Sylvania plant, one line is horseshoe-shaped. At the last station, the assembler puts the assembly fixture onto a gently sloping roller conveyor which returns the fixture to the first station.

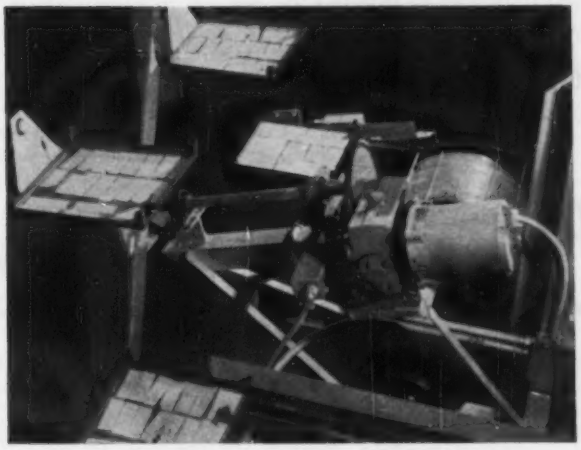
Lazy Susans (see cover) move subassemblies from operator to operator. Or, they move a series of parts to one operator in proper succession. Huge assemblies can sit still while the assemblers or testers roll parts and instrument carts from assembly to assembly.

Roller conveyors can also speed up warehousing. Westinghouse unloads large boxes of picture-tube envelopes at the high end of a series of conveyors. As one box is removed from the low end of the conveyor, another box slides into unloading position.



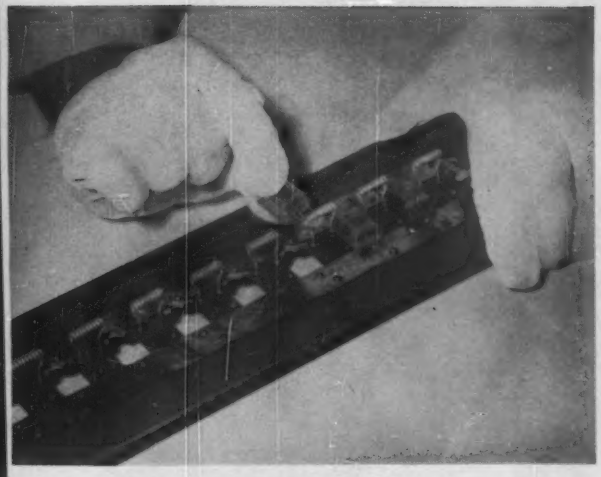
All utilities are routed through between-floors "basement" at Texas Instruments' plant

Skate conveyors are used at Hewlett-Packard as assembly work benches

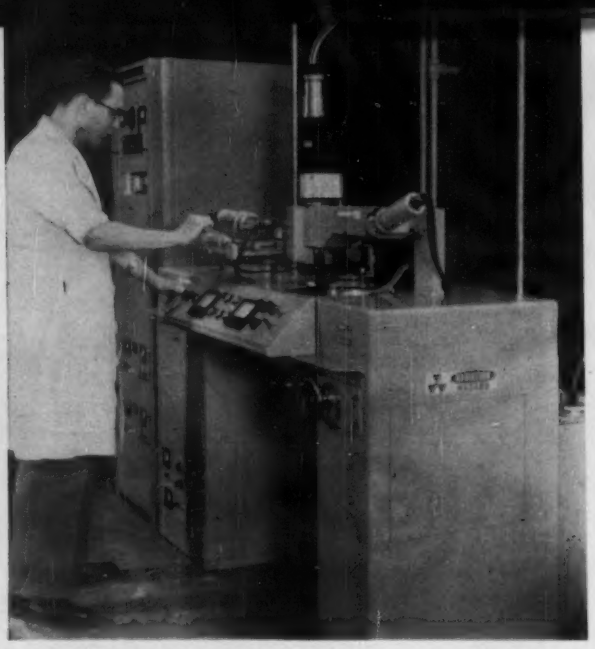


Pallets are shifted between conveyors moving in opposite directions at Gulton with this ferris-wheel transfer

Jig borer for high precision machining is operated in air-conditioned room at Lear's LearCal plant



New components under development include Westinghouse's matchbox tube that can be inserted into circuit board



X-ray machine developed by Bulova automatically positions quartz in cutting fixtures

Component production is becoming more fully automatic all the time. Printed wiring, dip soldering, vacuum metallizing, product redesign and standardization are steps towards full automation. Full mechanization of transistor and tube production seems feasible

PLAN '59

ADVANCES in COMPONENT PRODUCTION

AUTOMATION, in the sense used by the process industries, is rare in electronics. Component manufacturers, however, have taken significant steps in this direction. Some firms are using computers for routine design and production planning of components. A system which would have a computer direct the manufacture of a wide range of deposited carbon resistors is under development.

Pressure, both military and commercial, for ever-smaller, more heat-resistant components and circuits is considered by some to be forcing automation. There is a point at which hand methods lack the precision required for good product yields.

PRINTED WIRING—Perhaps the outstanding common denominator in modern electronics is the printed wiring board and dip soldering. The equipment is inherently flexible.

Step and repeat cameras are used by vendors and some plants so that several circuits can be precisely repeated on one board—later cut apart—from one master print. Coordinate-type drafting tables quickly ink or scribe precise masters and check finished boards.

For silk-screening, Hewlett-Packard uses a machine which has reduced application time by 70 percent. A vacuum table holds the board in place under the printing frame and an ink fountain automatically applies the proper amount of ink. Another commercially available machine employs a thermoplastic resist. Screened on hot, it dries on contact with the cool board so boards can go directly into etching tanks.

High-speed machines can place small parts in a board. Laboratory for Electronics reports that a recently acquired eyeletting machine inserts, stakes and solders some 8,000 units a day. Four girls who previously did the work inserted 2,000 to 3,000 a day.

Transistor cap is welded to base at Sylvania plant by automatically sequenced helium arc welder manufactured by Airco

VACUUM METALLIZING–Metallizing, used to produce such parts as crystal oscillators, film potentiometers and resistor-capacitor networks, is growing in importance.

The micromodule program which RCA is managing for the Signal Corps will require no R&D breakthroughs. Techniques in use today are considered sufficiently advanced to produce components required.

Components will be printed or attached on standard-sized ceramic wafers. Emphasis is placed on machine handling of parts too small for manual handling.

TRANSISTORS–Most transistor manufacturers have successfully mechanized both ends of their production line, through programmed crystal growers, ultrasonic or automatic crystal cutters, automatic dice sorters, etching machinery, programmed alloying furnaces, automatic cap filling, welding and cold-soldering machines.

Western Electric is now assembling grown junction transistors on indexing machines. Holders cut from metal ribbon replace the formed supports previously used to hold the bar crystal. Ribbon is fed into the machine, solder coated and bent like L's to hold both ends of the crystal. After the crystal is soldered in place, the ribbons are automatically welded to headers.

Another transistor design which permits less hand work is the diffused base transistor. Diffusion and evaporation of contacts are done before slices of crystals are cut apart into individual transistor elements. The elements are then etched and mounted.

ELECTRON TUBES–Tube manufacturers are highly mechanized in all but mount assembly.

Stacked mount construction, employed in the ceramic receiving tubes under development, shows promise of enabling full mechanization of some tube types. Ceramic spacers keep the metallic parts in alignment.

Power-tube production is so highly specialized that some operations are still done on glass lathes. Modern glass machinery is adaptable to a variety of tube types through changeable holding heads, jaws, flame jets, heating coils and other devices. Chatham Electronics, for one, uses its fast, new machines for short-run production. Older machines are set up for the continually produced tubes and those which require a lengthy setup procedure.

One technique which assists mechanization is slowing down process steps. Metallizing, for example, was almost explosive in early years. Slow metallizing enables more precise timing cycles.

CRYSTALS–A crystal production line being developed for the Signal Corps by Bulova Research and Development Lab has a crystal blank yield of 70 percent, compared with 46 percent for conventional processing.

Cuts are made after the quartz sections and stones are prepositioned in a fixture by an automatic X-ray machine. Blanks have a reference edge so they may be loaded into cartridges for automatic handling by sorters. The programmed vacuum metallizer plates both sides of 70 crystals in one vacuum. The masking fixture, built like an umbrella, flips the crystals over for plating on the second side. Final frequency adjustments are made on a spray plating machine. The spray gun's evaporation rate and shutter are automatically controlled by crystal frequency measurements.

SCRIBING–Scribing of delicate parts, such as crystals, is simplified with positioning fixtures. The parts can be placed on adhesive paper and held by a vacuum chuck. Templates and other large, flat items can be scribed with high precision on micrometer-set lofting boards.

Reticule scribing time has been reduced from 45 minutes, by hand, to two minutes with a machine at Hewlett-Packard. The reticule is fastened on a cam-driven table which carries the reticule under a scribing head. The head has five faces, each with a different combination of cutting tips.

Mechanization becomes compatible with extreme flexibility when single-station machinery is used. Modular circuit board layout permits more extensive use of programmed component inserters. Flow soldering lets board move through fluxing, soldering and cleaning in same conveyor

PLAN '59

MECHANIZING EQUIPMENT ASSEMBLY

THE VALUE of mechanized assembly in high-volume production has been amply reported by television, radio and data-processing manufacturers. Some machines demonstrate that mechanized assembly is compatible with flexible production.

Component firms have been making and packaging parts for automatic insertion for several years. Dimensional standardization of components, to make them more suitable for automatic insertion is aided by component packaging, preparation machines and the efforts of the industry associations and the military. The Signal Corps, for example, is setting up a grid system of component dimensions.

One component which has been especially troublesome, because of variations in blown bulb size, is the receiving tube. Westinghouse is developing for military use a square tube in a preformed case with straight-wire leads. It can be laid flat or nested in holes in a circuit board.

SINGLE-STATION MACHINES—A variety of machines—many of them single-station versions of stations in high-volume in-line transfer machines—are commercially available. They are most useful when a number of axial lead components is to be placed on printed wiring board or wire-wrap cards. The machines come as component preparation units, insertion-crimping or wrapping machines. Interchangeable or adjustable heads give them flexibility.

Some assembly machines have been specifically developed to insert a variety of axial-lead components in boards at a single station. Two of these are currently in use by International Business Machines and Western Electric. Though they differ radically in design, both achieve flexibility through circuit board design and a programming system.

Western Electric's machine will select and mount up to 50 components. These are fed through magazines mounted vertically around the outside of the oval-shaped machine. All operations are controlled by punched tape.

On insertion of a circuit board, a servomechanism places it in position to accept the first component. The tape also triggers a solenoid at the magazine holding the desired component. The component drops into a receiving position, where it is picked up by an arm rotating under the magazines. The arm carries it to the insertion head which has been adjusted meanwhile to suit the physical characteristics of the component.

The IBM machine accepts circuits with a standardized wiring pattern containing 24 component positions. This pattern layout also serves as a common denominator in preparation of printed circuit boards.

Any of 14 axial-lead components can be placed in any of the 24 locations during a traverse of the single insertion head. The components are reel-fed into a common track. A moving jet of air glides them along the track into the insertion head. Location of the head over the board is determined by combined action of ¼, ½, 1, 2 and 4-inch air cylinders. Another air cylinder puts the board in insertion position.

The air pulse combinations which locate the insertion head and the order in which components are stripped from the reels are selected by 24 dial-type switches. In another machine with higher capacity, programming is controlled by punched cards.

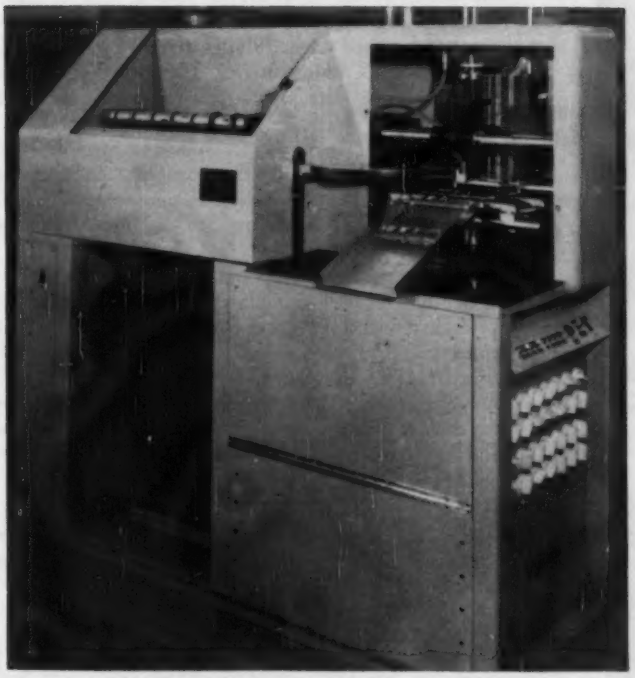
Both machines depend on board layout according to a standard modular or grid system. Odd-shaped components are later added by single-station machines or hand assembly.

MECHANIZED WIRING—Mechanized wiring machines are coming into use. A programmed machine to produce complicated wiring patterns by the wire-wrap method has been developed for Hughes.

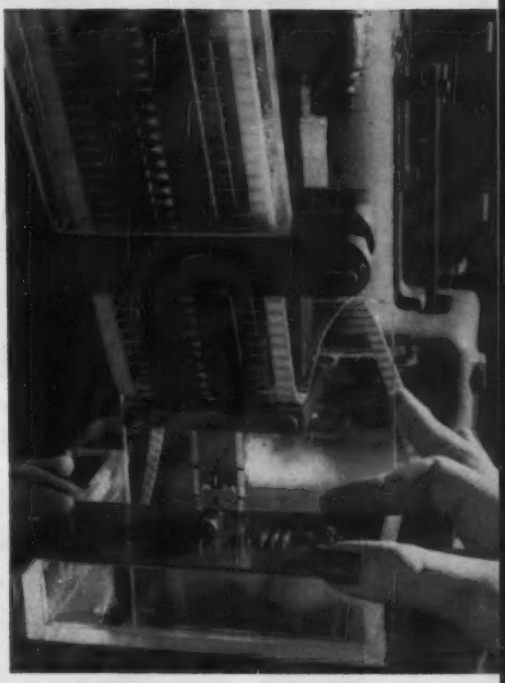
Plants which cannot use such machines can, however, avoid excessive labor in wire preparation. Cutter-strippers with such quick change features as lead-length control dials and interchangeable stripping heads will turn out thousands of pieces of wire in an hour, or a few at a time.

A setup coming into wide use has an induction heater placed before the cutter-stripper and synchronized to

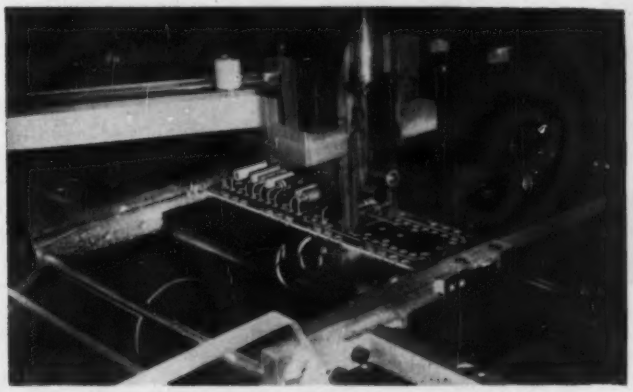
In-line inserting machine at Burrough's plant turns out a printed wiring board every four seconds; 17 stations insert 48 components



Desk-sized IBM insertion machine places up to 14 components on board after part and position are selected by switches

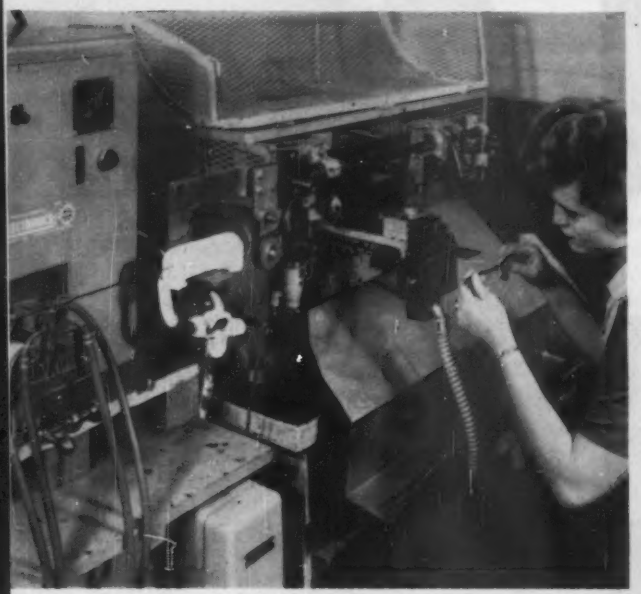


Single-station component insertion machine at Hughes



Insertion head of IBM machine is positioned by air cylinders

Single-station machine built by Polarad Electronics to feed, insert and clinch turret lugs in terminal boards



Reeve Electronics wire cutter-stripper setup has synchronized induction heater which melts tin plating and bonds wire at cut

heat the wire at the cut point. Adler Electronics reports that the heater by bonding the strands eliminates the need to retwist multiconductor wire. Hewlett-Packard twists up to four precut jumper wires together by passing them through four rubber rollers, rotated like washing machine wringers.

General Electric's light military equipment department devised a wire coding machine to reduce wire stocking, purchase and inventory expense. As many as 22 color code combinations in five wire sizes are required. The machine color codes white wire with multiple printing heads. The heads are stacked vertically so that ink rollers can be pushed against the wire as it is drawn through the machine.

DIP SOLDERING—A few years ago, dip soldering was literally dip soldering. Assembled boards were dipped by hand, fixture or conveyor into a well containing solder wiped free of dross. An alternative conveyor method pumped solder through tubes to selected points on the board's under surface. These methods are used by many electronics plants today because they are fast and effective.

The current trend in assembly-line dip-soldering is to flow the solder while the board moves against the flow. In one method, solder is pumped up to board level in a wave or fountain. Another type pumps the solder in ripples.

Dross does not collect on the solder surface. The solder adheres well without a jiggling step. Boards may be carried over fluxing and cleaning rollers on the same conveyor. Conveyors either carry pallets or have tracks adjustable to board width.

In a combination of dip and flow soldering, boards are dipped into a horizontal stream of dross-free solder and removed at an angle as the stream bathes the board's underside.

TESTING—Most plants use one or more kinds of automatic test stations. Some firms, such as Transonics, concentrate their automation efforts on in-process tests and calibration centers built by company engineers. Electronic Specialty Co. builds patch boards into its test units so that the units can be used for a number of applications by relacing the patchboard. Other plants favor prewired patch boards which can be plugged into the test station. Programmed testers are commercially available.

Some companies prefer to make even the simplest tests automatic because employees fatigued from reading meters all day are likely to make mistakes. Even a simple go, no-go operation can become confusing in time, they report. Belted components simplify automatic test station feeding. Test results of expensive or critical components, such as tubes and transistors, can be logged on punched cards for later comparison with field experience.

There are two schools of circuit testing. One group favors functional testing, for overall performance of the circuit. Another tests all components of the assembled circuit. The latter method reduces interpretation by the operator and is believed to afford more precise production quality control.

Doctor adjusts video clipping level control for maximum contrast. Ink recorder at extreme right provides densograms

Video Microplanimeter Detects Bone Disease

Electronic scanner using television flying-spot microscope measures tiny tissue areas of spongy human bone in locating common but difficult to diagnose disease. Densogram gives percentage of marrow in a differential area

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OSTEOPOROSIS, a metabolic bone disease in which the total body mass of bone is less than that of a normally active person of comparable size, results when new bone matrices fail to develop. The bony tissue that exists in osteoporosis, however, is qualitatively indistinguishable from normal bone.

During recent investigations of the disease it was necessary to measure irregular microscopic tissue areas of spongy bone to find the ratio between chemical composition and bone area as it relates to skeletal density. Roentgenologic changes in the bony skeleton do not appear until late in the disease and do not help in diagnosing the early case. Because subjective evaluation of bone area from microscopic slides is impossible, it is necessary to measure bone area quantitatively. Since the entire bone matrix is normally calcified in both normal and osteoporotic bone, decalcified bone area is a function of bone volume and density.

In the past, the area of trabecular bone as represented on histologic slides has been determined by time-consuming polar planimetry, weight analysis of paper overlays or random dot or grid analysis. This article describes an electronic scanner that uses a television flying-spot microscope to measure irregular areas of cancellous bone.

Block Diagram

The block diagram of Fig. 1 shows the video microplanimeter for measuring bone versus marrow areas in microscopic sections.

The sweep and blanking gener-

BONE . . .

. . . can be divided into two major types; compact bone and spongy or cancellous bone. Compact bone is a dense, hard substance with microscopic voids. Spongy bone is less dense than compact bone and is composed of many small interlocking struts of bone or trabeculae. The long bones of the body are tubular structures composed of compact bone. The flat bones have an outer shell of compact or cortical bone. Within the shell of cortex is the spongy or cancellous bone

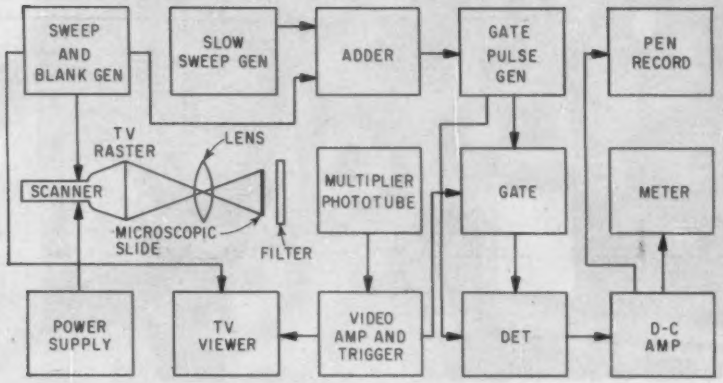

FIG. 1—Video microplanimeter tv raster, lens system and multiplier phototube

ator causes the bright blue spot on the face of a 5WP15 crt scanner to trace a tv raster. A lens reduces the raster to the size of the bone section under test. As the spot passes over marrow areas, some light is transmitted through the bone sections onto the multiplier phototube. Electrical output from the multiplier phototube is clipped by a Schmitt trigger and video amplifier and the resulting d-c component is proportional to the percentage of solid bone area. It is detected, amplified by a d-c amplifier and read on an output meter.

While the tv viewer monitors an enlarged picture of the bone section, it primarily aids in centering the section and adjusting contrast. A gate provides an electronic window which enables the operator to analyze only a small portion of the bone section. A densogram is recorded on the pen recorder when the electronic window is automatically swept across the tv raster by the slow-sweep generator. The adder and the gate pulse generator synchronize the opening of the gate with the tv vertical sweep.

Operation

In operation, the slide is positioned so that the entire bone section, except the cortex, appears without margins on the tv viewer. The clipping level is then adjusted for optimum contrast. A reading of the average percentage of solid bone for the entire section appearing on the viewer is then taken from the output meter. A densogram, which depicts the distribution of solid bone throughout the section is finally recorded.

The video preamplifier output voltage representing black, white and all shades of gray passes through a Schmitt trigger window amplifier. Voltages are then black or white depending upon the window limits.

A clipping level control varies bias on the preamplifier output cathode follower, thus determining the direct current component of the input to Schmitt trigger V_1 in Fig. 2. Diode clamping prevents the clipping level from changing as the black to white ratio varies. Schmitt-trigger output feeds video amplifiers V_{2A} and V_{2B}, and the video input to the viewer is taken from V_{3A}.

Output from V_{2B} is also coupled into cathode-coupled gate V_{4A} and video amplifier V_{4B}. Diode D_1 clamps the video negative peaks at ground potential. The direct current component is then directly proportional to percentage of opaque area in the microscopic section. Rapid video components are removed by an L-C π network. The filter is sufficiently slow to remove the a-c from the horizontal scans but is unable to remove detail from a vertical scan. Filtered output or densogram can be viewed on an oscilloscope and recorded photographically. Simultaneously, it is coupled to the input of d-c amplifier V_5.

Output from V_5 is indicated on a meter and a pen recorder, and the

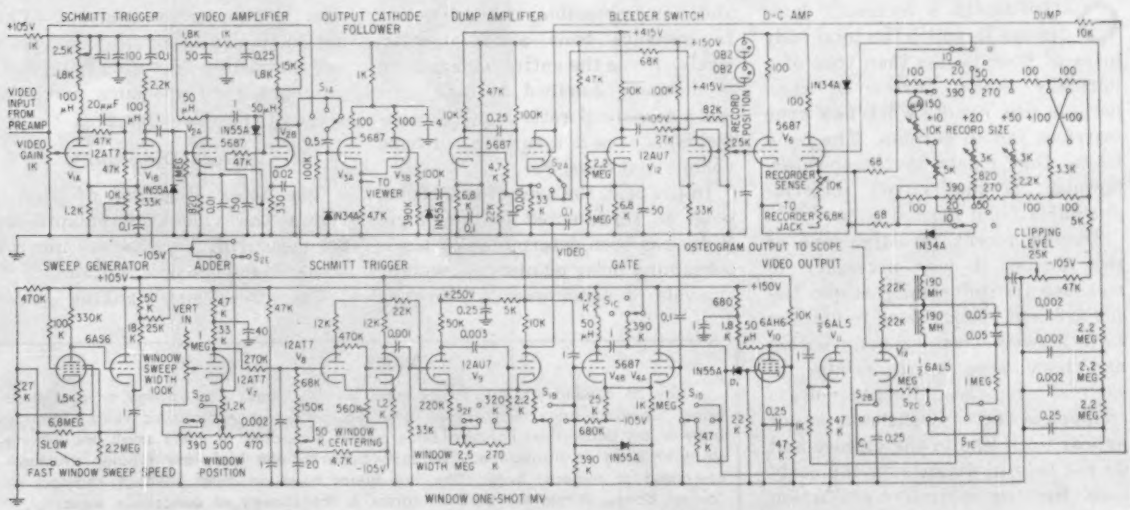

FIG. 2—Osteograph analyzer has window-width control in one-shot multivibrator that turns on gate

amplifier itself is balanced for null at any percentage of nonopaque area. Full scale meter ranges of 10, 20, 50 and 100 percent are provided.

Recording Densogram

To record the densogram on paper, a vertical scan slow enough to be followed by a pen recorder has to be used. The scan must not, however, be so slow as to preclude the use of a television viewer. A second vertical sweep which slowly scans an electronic sampling window across the television raster satisfies these needs. Sweep speeds of 7 or 30 sec/sweep are available.

The normal 20-cps vertical sweep is coupled through adder V_7 into Schmitt trigger V_8. When the bias on the adder is manually varied, the portion of the sweep sawtooth falling within the Schmitt-window limits also varies. Thus, the leading edge of the Schmitt output square wave moves across the vertical sweep. For automatic sweep a sawtooth voltage, generated by a cathode-coupled phantastron, can be substituted for the manual bias.

The differentiated leading edge of the Schmitt output triggers one-shot multivibrator V_9 which opens gate V_4. A window-width control varies the multivibrator ON time. Output from the one shot blanks the viewer so that the window is seen as a dark band. The gated video passes through amplifier V_{10}, is diode-clamped in V_{11} and passes through a short time constant filter. The d-c component is diode-coupled into 0.25-μf storage capacitor C_1 where the information is stored until just before another video sample is taken. At that time it is dumped by the differentiated leading edge of the one-shot pulse.

Storage capacitor C_1 is used only on short video samples, because it holds at the peak value. To obtain an average over a longer sample, bleeder-switch tube V_{12} connects the bleeder for the duration of the video sample and removes it during the interval between samples.

Capacitor C_1 is connected to the input of output cathode follower V_6 whose output, recorded as a function of time, is the densogram.

An enlarged televised picture of the histologic section appears on the viewer. The sweep width and positioning controls are adjusted so that the television raster just covers the section. It is important that there be no margins, since they would be included in the reading of average marrow percentage.

The output meter is adjusted by manually positioning the electronic scanning window on all black or all white portions of the section. Sections of bone, however, are seldom all black or all white. Turning down the video gain simulates black. All white is simulated by turning off the gate pulse.

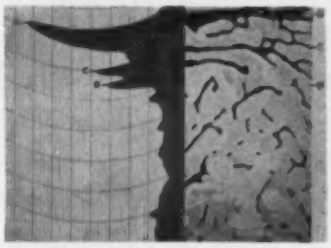

FIG. 3—Densogram (left) and photomicrograph (right) of section of spongy bone show bony trabeculae (dark areas) and bone marrow (light areas)

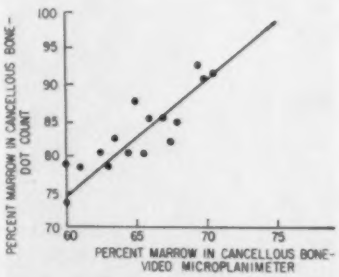

FIG. 4—Percentage marrow in cancellous bone obtained by random dot count in plotted on ordinate while similar percentages of planimeter are on abscissa

A reading of the average percentage of marrow, including the entire histologic section except the bone cortex, is taken. The gate is opened to include the entire tv raster in this reading.

The swept electronic scanning window is then turned on and a densogram recorded. Scanning is along the long axis of the section shown in Fig. 3. Deflection of the pen represents average percentage of marrow in a differential area perpendicular to the scanning axis.

A plot of output meter readings as compared to percentages obtained arithmetically from random dot counts is shown in Fig. 4. Arithmetically determined values are accurate to about three percent marrow. The average deviation of points from the mean curve is 2.3 percent marrow (2.7 percent error) as read on the ordinate scale. Output meter readings are repeatable to about one percent marrow.

Factors which influence instrument accuracy include loss of video during sweep blanking and imperfect sweep linearity. Operational errors result from solid margins around the section and incorrect setting of the video clipping level.

The cancellous bone in this study is obtained from a specific area of hip bone in a series of autopsied and biopsied cases of normal and clinically osteoporotic persons.

After decalcification, the bone cylinder is dehydrated, embedded in celloidin and sectioned at 10 microns. The tissue sections are mounted on slides and stained by picric acid and fuchsin. Decalcified bone material becomes bright red and the intervening bone marrow a contrasting pale greenish-yellow.

Photomicrographs are made of the series of bones and from these the ratio between bone area and marrow area is determined by weight analysis of paper overlays or cutouts, and random dot or grid analysis. Weight analyses give an accuracy of ± 2 percent; grid analyses are accurate to ± 3 percent.

This project was sponsored by Dr. J. T. Crane of the University of California Medical Center. The scanner was developed under the direction of R. S. Mackay. We are indebted to D. Colburn, who designed the basic scanner circuits.

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Waveguide Coils Make Compact Delay Lines

Production testing of microwave electronic equipment is simplified with compact delay line made from a number of tightly wound waveguide coils. Turntable, coil form and flexible steel mandrel with accessories bend 40-ft lengths of waveguide into tight coils. A 240-ft delay-line unit consisting of six 40-ft coils has insertion loss of 21 db with maximum vswr of 1.5

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WAVEGUIDE DELAY LINES used in the development and testing of electronic equipment are usually hung from ceilings or walls. The hundreds of feet of waveguide required to make up a loop frequently make such awkward layouts unavoidable. To reduce the delay lines into a portable unit, a technique was developed for forming 40-ft lengths of waveguide tubing into tight coils. With the addition of flanges and elbows, the coils can then be assembled into a compact delay line of any desired length.

Preventing Collapse

Internal support must be provided to prevent the thin walls of waveguide tubing from collapsing during bending. Sand, rosin, low-temperature fusible alloys or flexible steel mandrels usually provide the internal support. In this procedure a short flexible steel mandrel forms 40-ft length of tubing into a coil.

Forming the sharp one-in. radius bend which joins alternate coils in the region of the inside diameter similarly presents a special problem in bending. Because of the severe change in shape which takes place while cold-forming the waveguide to a one-in. radius, this end of the tubing must be annealed before bending. The metal then flows more freely while forming and the material keeps its changed shape after removal of the cold-forming forces. (Type 2S aluminum tubing is annealed at 700F. Type 90—10 commercial bronze or brass tubing is annealed at 1100F in an inert gas atmosphere).

Technician has placed clamp over 40-ft coil of waveguide to prevent unwinding before tack welding

The forming equipment consists essentially of a turntable, a coil form, a flexible steel mandrel with rigid positioner and a fixed pipe which guides the waveguide and anchors the mandrel positioner. Since internal support is required only in the region where the forming takes place, only a short 18-in. mandrel is necessary, provided it can be held at all times in the forming region.

The laminated spring-steel mandrel shown in Fig. 1 consists of a number of leaves of 0.005-in. thick clock-spring steel and provides the internal support by filling the inside of the tubing. The mandrel is held in the region where the forming takes place with a mandrel positioner and clamping fixture. The equipment is best described by following the step-by-step formation of a coil.

Coil Forming

The waveguide and mandrel positioner are initially loaded into the pipe so that both waveguide and point *A* of positioner in Fig. 1 extend about 12-in. beyond the end of the pipe. With the waveguide in this position, the waveguide clamp and the clamp for mandrel positioner are secured. With the cable fastened to the turntable pulley, the waveguide is then drawn over the oiled spring-steel mandrel until the

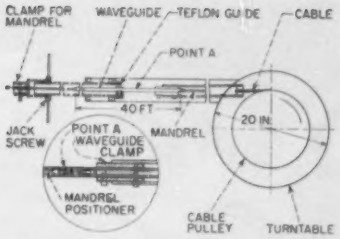


FIG. 1—Diagram of waveguide being drawn over mandrel. Portion of waveguide and positioner are in insert

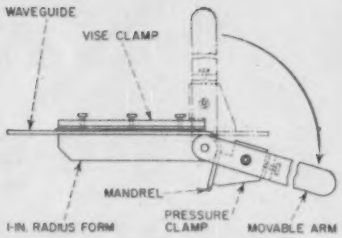


FIG. 2—Rectangular waveguide tubing is drawn into 1-in. radius by manual rotation of the movable arm

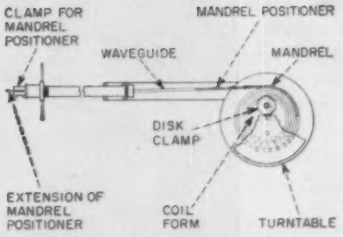


FIG. 3—Final setup for winding waveguide into 40-ft coils. Mandrel is held in position where the forming takes place

end of the waveguide is flush with the end of the mandrel. Figure 1 shows the waveguide partially drawn over the mandrel.

Waveguide clamp, mandrel positioner clamp and cable pulley on the turntable are then removed. Thus, the mandrel-filled end of the waveguide, which has been previously annealed, is placed in the bender that forms the initial one-in. radius bend shown in Fig. 2. The bender is attached adjacent to the turntable in line with the pipe to make removal of the mandrel-filled waveguide from the pipe while making the initial bend unnecessary. The mandrel-filled waveguide is then placed in the bender and secured in the vise clamp with the end of the waveguide extending about 4.5 in. beyond the center line of the 1-in. radius form. The end of the waveguide is now formed into a 1-in. radius with 125-deg bend by manual rotation of the movable arm indicated in Fig. 2.

The waveguide is then removed from the bender and placed in the 1-in. radius slot of the 8-in. diameter coil form which has been secured on the turntable of Fig. 3 in place of the cable pulley. The initial bend of waveguide is held in the coil form with the disk clamp. The cover is then fastened to the coil form, making a spool for the waveguide which is about to be wound. The clamp for the mandrel positioner is secured at the other end.

A few turns of the jack screw frees the mandrel which is contained within the waveguide at the initial bend. The waveguide then slides more freely over the mandrel while it is being wound. The turntable rotates until the full 40-ft length of the waveguide is wound into a tight coil. As soon as the mandrel starts to become exposed, the turntable is stopped to prevent the coil from unwinding while the cover and disk clamp are removed.

Another clamp is placed over the periphery of the coiled waveguide and the coil is manually withdrawn from the mandrel. The clamp remains on the coiled waveguide until it is tack welded at the outermost point of tangency. Before tack welding, the coil form is removed and the coiled waveguide immersed in a degreasing solution to remove the oil used as a lubricant in winding.

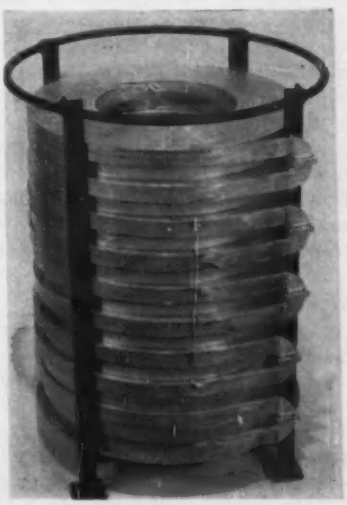
Joining Coils

To facilitate joining the coils to each other, flanges and elbows are then brazed to the ends of the coils. Thus, delay lines of any length may be readily assembled. This technique permits cold forming of 40-ft. lengths of rectangular waveguide tubing into tight coils, without altering the critical internal accuracy and surface finishes. Both mechanical and electrical reproducibility are readily achieved.

Performance

Electrical performance of waveguide tubing coiled in this manner is satisfactory. The attenuation of a 40-ft section of half-size X-band straight waveguide whose inner dimensions are 0.2 by 0.9 in. measured roughly 3.2 db, as compared with 3.2 to 4 db for coiled guide. A conventional waveguide delay line, 240 ft long, consisting of straight waveguide sections, joints and elbows, measured 25 db with a maximum vswr of 1.75. The same length delay line, coiled and assembled in 40-ft coils gave an insertion loss of only 21 db with a maximum vswr of 1.25 over a 1,000 megacycle frequency range. A compact, portable delay line made up of a series of waveguide coils, properly joined together, therefore offers somewhat superior electrical characteristics than those of the conventional stationary loops.

A 40-ft waveguide coil is compared to a six-in. rule to indicate space-saving attained using this method



Packaged delay-line, consisting of 760 ft of coiled waveguide with outer diameter of 16 in., does away with space-consuming hanging delay lines

Machine tool in operation at Firth Sterling is independently timed, servo controlled

Spark Machine Tool Has

With attention being given to difficult-to-machine materials as possible sources of new semiconductor devices, spark machining increases in importance. It offers economical working of otherwise unmachinable materials and high-temperature alloys and easy forming of unusual shapes and surfaces. Here's the story on a new, independently timed, servo-controlled system

SPARK-MACHINING THEORY has been the subject of considerable controversy.[1-3] But it is known that work is accomplished by mechanical forces accompanied by some thermal action.[4] In the absence of precise theoretical considerations, electrical performance specifications for power supplies have taken forms which are an outgrowth of design convenience and limited operational tests. Numerous improvements have been made over the earliest equipment. This article describes a modern unit which achieves a high machining speed.

Figure 1 shows a high-power spark-machine system now in commercial use. The unit is powered from a 4.5-kv three-phase rectifier of conventional design. Energy-storage capacitors are discharged sequentially by a rotary spark gap through the primary of a 100-to-1 voltage-ratio pulse transformer. Secondary of the transformer feeds the machining operation. Characteristics of the system are: pulse repetition rate, 2,880 pps; pulse duration, 17 μsec; peak pulse power, 450 kw; peak open-circuit gap voltage, 100 v; peak discharge current, 4,500 amp and average load volt-amp, 11 kva.

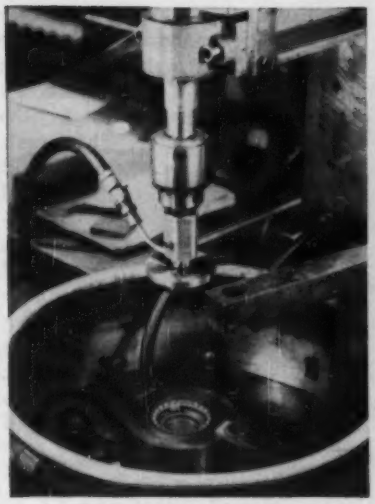
Because of the poor power absorbing characteristics of the load, the oscillatory discharge is lightly damped. Most of the pulse energy is stored after the initial forward pulse in the form of reversed charge on the energy-storage capacitor. This results in a tendency to follow the forward pulse with a reversed polarity pulse. This energy must be absorbed to prevent undue tool electrode wear and to improve deionization in the rotary gap. A bank of 6C21's, diode connected, is used for this purpose.

The loading system, for cost reasons, is somewhat light and is only slightly more than the minimum necessary to maintain stable rotary-gap operation.

Rotary-Gap Design

The rotary gap has four stationary pins, each fed from a separate energy source, and 12 rotary pins. The sequential discharge system achieves a high repetition rate without excessive peripheral speed. At the same time, the rate of voltage rise across each discharge gap because of the capacitor charge cycle is reduced considerably over that developed with a single stationary pin.

An unusual design problem was



Tool and die mounted in spark machine

Rotary gap for pulse switching

Servo Control

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presented by the pulse transformer. Effective primary-circuit inductance—a combination of reflected secondary inductance and primary magnetizing inductance — determines the pulse duration through the L-C character of the discharge circuit. When a discharge fails to take place at the machining gap, primary inductance alone is effective. As a result, an excessively long pulse may result which can cause difficulty in switching-gap deionization. To avoid this difficulty, the primary is designed both for relatively high magnetizing current and core saturation after a pulse duration about equal to the normal pulse length.

Since machining action in a spark-machine tool is effected by electrical discharges, position information required to actuate a tool-positioning servo can be derived directly from electrical quantities in the discharge.

In independently-timed machines, information is derived in the following manner. At the beginning of each pulse, the voltage between the tool and work rises so rapidly that a constant amplitude is reached before breakdown can take place. This action results because of the finite time lag between application of a voltage and resulting sparkover. This time delay is a function of gap spacing. Sparkover takes place early in the pulse ON period for short tool-to-electrode spacings, later for greater spacings and not at all for spacings too great for the voltage.

Complete System

The circuit diagram of a complete servo control for a heavy machine tool is shown in Fig. 2. Position information is derived from the gap voltage as explained previously. The gap voltage is fed to an integrating circuit via diode V_1. This diode is useful because the damping diodes on the pulse transformer primary (Fig. 1) are not designed to clip sharply the reverse voltage which appears at the end of the forward capacitor discharge cycle. As a result, some reverse voltage appears across the tool-to-work gap at the end of each machining pulse. The diode eliminates this meaningless reverse voltage from the information channel of the servo circuits. It also prevents discharge of the integrating capacitor back through the low-resistance path of the pulse-transformer secondary after the end of each applied pulse.

The resistor-capacitor networks on the output of diode V_1 serve two purposes. First, they form an integrating circuit with a time constant such that an appreciable voltage is developed across C_1 during the short pulse ON period. This voltage is proportional to the fraction of the pulse ON interval before sparkover takes place. Secondly, the resistor circuit discharges C_1 during the long pulse OFF period between pulses.

Matching of the time constants and the general voltage level on C_1

HOW ELECTRIC SPARK MACHINING WORKS

Series of electrical discharges pass in a liquid dielectric, commonly a hydrocarbon, between a tool electrode (cathode) and workpiece (anode). Each discharge is initiated by sparkover of dielectric. Discharges cause erosion of both tool and adjacent portion of workpiece. Tool is manipulated above workpiece until desired shape is produced.

Automatic controls can be used to position tool close enough to workpiece to permit sparkover at voltage selected for machining conditions desired. Voltages range from 40 to 300 v; discharge currents from a few to 20,000 amp; sparkover durations from fraction of a μsec to 200 μsec and repetition rates from a few to 50,000 pps

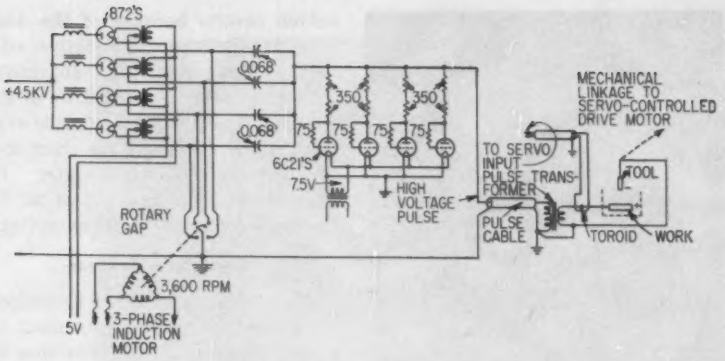

FIG. 1—Schematic diagram of power components of high-power electric-spark machine

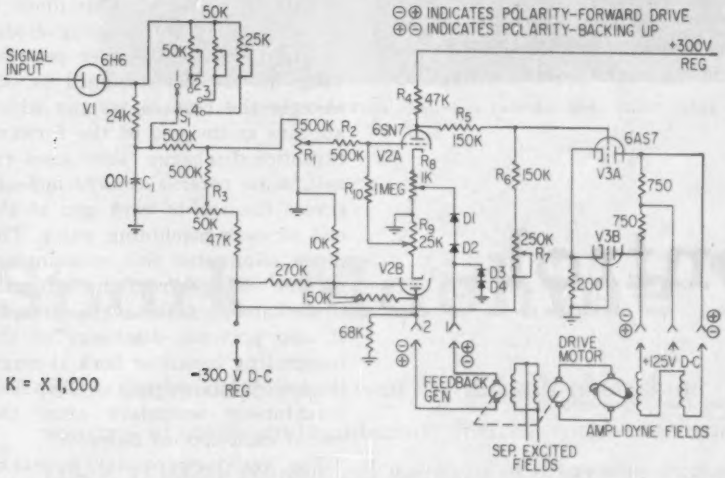

FIG. 2—Circuitry for electrode drive-motor servo. Unit uses a separately excited high-torque d-c motor controlled by amplidyne generator

to the pulse length of the pulse power supply is important. Switch S_1 selects the proper input resistor in the integrating circuit to match the four machining conditions provided in the pulse power supply.

The signal from C_1 is fed through gain control R_1 and resistor R_2 to the grid of V_{2A}. Output of V_{2A} feeds a cathode-coupled push-pull d-c amplifier used to excite the field of an amplidyne generator in the circuit displayed. Field excitation derived from the difference in plate currents of V_{2A} and V_{2B} comprises a net excitation of polarity and amplitude proportional to the difference existing in the grid voltages of V_{2A} and V_{2B}. Corresponding output of the amplidyne varies both in sign and amplitude causing the tool or electrode to advance toward or withdraw from the workpiece at a varying rate as required by conditions. The system operates to provide electrode spacing control to maintain a working gap spacing greater than zero and less than 0.001 in.

To achieve the necessary control, the positive signal on C_1 is mixed with a regulated negative reference voltage. Adjustment of R_2 allows selection of proper operating potential for the grid of amplifier V_{2A}. A series divider chain—R_4, R_5, R_6 and R_7 together with the regulated positive supply—establishes the desired operating bias for output stage V_3.

Feedback Relations

Although the d-c amplifiers are not particularly high-gain circuits, the entire system constitutes a high-sensitivity servo circuit because of the high current and power gain of the amplidyne. To assure system stability, velocity feedback is provided by a small feedback generator driven directly by the electrode drive motor. The circuit is arranged so that the amount of feedback is greater in the infeed drive than in the reverse-drive direction to assure rapid electrode withdrawal from a contaminated working gap. Feedback is nonlinear in both directions but is made much larger in the infeed drive direction to allow the system to make a fast advance toward the workpiece to initiate a cut. It also permits rapid readjustment of the drive-motor speed.

Positive Feedback

Positive feedback is made available by the velocity generator at the onset of gap conditions requiring motor reversal. This positive feedback continues until the drive motor has reversed. In the infeed drive direction, the velocity-feedback generator develops a voltage such that terminal 1 is positive with respect to terminal 2. This voltage is proportional to the drive-motor speed. The infeed signal corresponds to a positive signal on the grid of V_{2A}. Negative feedback is effected by the circuit from terminal 1 through rectifiers D_1 and D_2 and through R_8 to ground. Corresponding positive signal at the cathode of V_{2A} reduces the effect of the positive signal voltage on its grid.

In the reverse-drive direction, positive voltage from the feedback generator appears on terminal 2. This voltage is applied to the plate of V_{2B} which draws current roughly proportional to its plate voltage. Portion of the drop across cathode resistor R_9 is applied through series resistor R_{10} to the grid of V_{2A}. Adjustment of R_9 permits selection of the upper limit of drive-motor speed in the reverse direction.

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(1) E. M. Williams, Theory of Electric Spark Machining, *Transactions AIEE*, 71, 1952.

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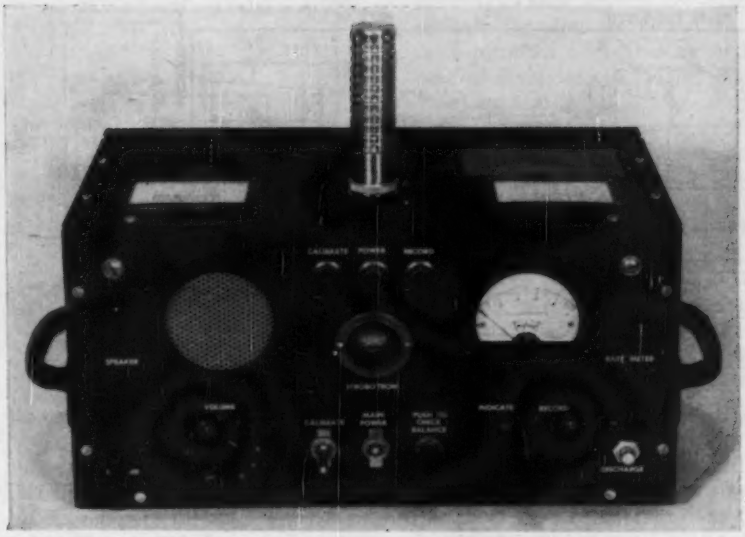
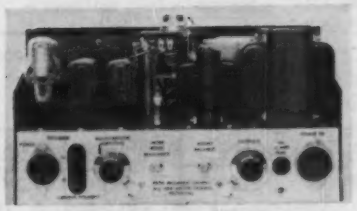
(3) B. N. Solotych, Physical Fundamentals of Electric-Spark Working of Metals, *Schriftenreihe des Verlages Technik*, 175, VEB Verlag Technik, Berlin, 1955.

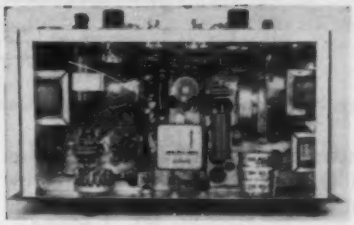
(4) E. M. Williams and R. E. Smith, Low-Voltage Discharges in Liquid Dielectrics, *Communications and Electronics* (AIEE), No. 18, p 164, May 1955.



All functions of monitor except recording are self-contained. Strobotron firings are displayed on front panel to provide visual indication of radiation occurance



Locking adjustments of all calibrating controls are made at rear skirt



Cabled wiring and turret sockets provide clean under-chassis appearance

Geiger Radiation Monitor Indicates Continuously

Using easily available and inexpensive components, this Geiger counter fills the gap between portable field equipment and elaborate fixed installations that monitor industrial areas containing radio-active materials. Equipment is internally calibrated and provides both aural and visual indication of hot loads. Continuous recording of count output may be added

By **RONALD L. IVES,** Palo Alto, California

INCREASING industrial use of radioactive materials demands continuous monitoring of radiation background around areas in which such materials are used. The monitoring equipment should be low-priced, simple in construction, easily repairable, and operable by nontechnical personnel. Integral calibration checks are desirable for continuous indication or recording.

Basic Monitor

The basic design given here fills most ordinary monitoring needs and, because of its fundamental simplicity, modifications to fill special needs are simply and economically made. A block diagram of the monitor is shown in Fig. 1.

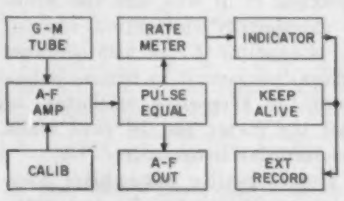


Fig. 1—Functional diagram of monitor

The single-stage audio amplifier is biased off during calibration. The remainder of the calibrator is an electromechanical pulse generator, comprising a 7.5-rpm clock motor with an eight-tooth cam on its shaft to actuate a microswitch. As the switch arm passes over each cam tooth, C_1 of Fig. 2 is charged from the regulated power supply, then discharged through V_2 into the pulse equalizer.

The alternate charge and discharge produced by the cam gives an output of 1 pps for checking the

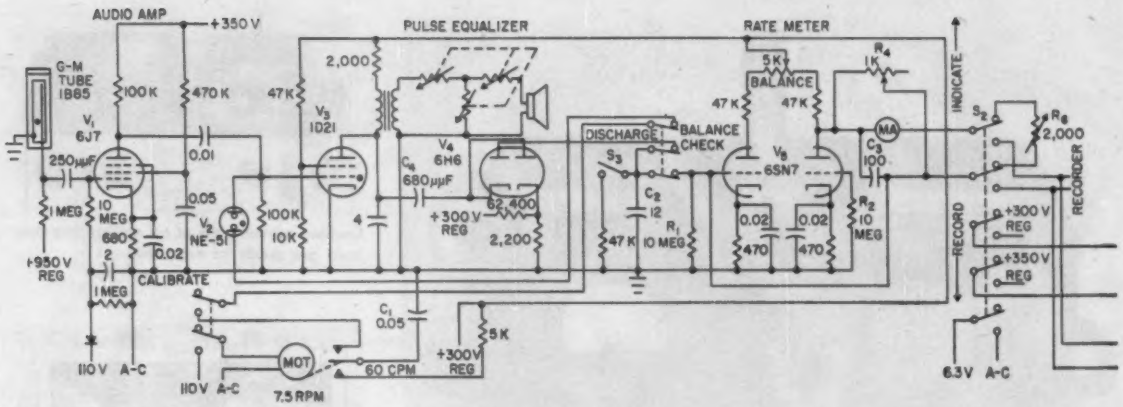


Fig. 2—Complete schematic of basic monitor and optional recording function. When recording is not required, switch S_2 and all

ratemeter calibration[1]. The purpose of the neon bulb is to isolate the pulse equalizer grid from the switch line.

The pulse equalizer uses Strobotron V_2 operated from a regulated power supply with constant load. The plate voltage swing, produced by an incoming pulse above minimum, is from 300 v to the 15-v extinction of the tube. This extinction voltage remains constant at low and medium counting rates throughout the tube life. At rates exceeding 200 cps the extinction voltage changes and operation above 250 cps is not recommended.

Auxiliary Count

The output transformer loading V_5 drives a loudspeaker through a variable-T attenuator. If audio output is not desired a 5,000-ohm plate resistor can replace the transformer, or auxiliary count output can be obtained at this point by using a fairly sensitive relay. Flybacks are avoided by resistively damping the relay. The combination of a 5,000-ohm relay with a 4,700-ohm shunt works well.

Completing the pulse equalizer is dual diode V_4. Its lower cathode is biased slightly positive to cancel out contact potential. The diode output is one 285-v negative pulse for each count detected by the G-M tube or generated by the calibrator.

The rate meter is entirely conventional. Incoming pulses are stored in paper capacitor C_3 and slowly bled off through R_1. This also serves as the grid resistor at the difference-amplifier input. An equal resistance R_2 is inserted in the grid of the other half of V_5 to equalize contact potentials and make the circuits substantially immune to emission differences between tubes.

Pushbutton S_3 disconnects the storage capacitor, diode input and calibrator input, to permit checking of balance without disturbing the approximate reading of the instrument.

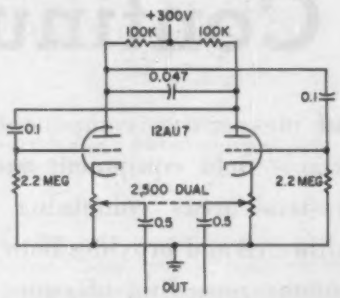


Fig. 3—Optional keep-alive oscillator circuit for radiation monitor

Indicator and recorder takeoff is from plate to plate of V_5. The milliammeter is connected in series with the recorder or a substitute resistor, either of which can be switched in at will, and the whole is shunted by calibration resistor R_1. Capacitor C_3 is also shunted across this circuit to bypass pulses from the keep-alive oscillator, so that the meter can be read while the recorder is operating.

The keep-alive machanism comprises multivibrator V_6 and cathode follower V_7. This supplies small alternating pulses to the recorder, to overcome deviations caused by paper grain and stickage. The circuit has been described elsewhere[2]; a simplified version is shown in Fig. 3.

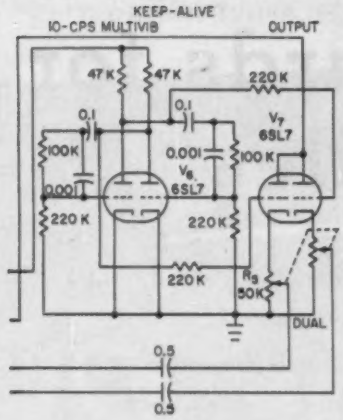
Calibration

Preliminary adjustment and calibration is simple and straightforward, requiring no special instruments. After a warmup of about 15 minutes, rate meter balance is adjusted. This is done with switch S_2 in the INDICATE position, resistor R_1 at maximum value and pushbutton S_3 depressed. The balance potentiometer is then adjusted until the indicating meter reads zero.

With S_3 released and S_2 depressed, indicator zero will be held if the V_5 contact potentials are properly offset by the bias network. Component values shown are satisfactory for about 90 percent of stock tubes, so a replacement is indicated if balance is off.

Next the recorder is connected and R_6 adjusted to the desired value. The calibrator is turned on and allowed to run until instruments reach maximum value. This takes a while, as the time constant of the rate meter is 120 sec. Calibration control R_4 is adjusted until the panel meter reads 0.6 ma. The recorder, being in series with it, should read the same.

The recorder is then turned off, leaving the calibrator on, and resistor R_6 is adjusted until the panel



components to right of it are deleted

meter again reads 0.6 ma. The monitor will now give the same reading whether or not the recorder is in the circuit.

Then with the calibrator off, the monitor will indicate or record local Geiger background. This will run from 25 to 40 counts per minute at sea level in the absence of abnormal local radioactivity, using components specified in Fig. 2. Normal counts for tubes of other types are obtainable from the manufacturers, and for elevated or contaminated locations they are best found by local tests.

With the instrument in continuous operation at a fixed location, balance and calibration checks are made once each work shift. This is logged and authorities are notified if either is off by more than one scale division.

Permanent Record

Typical recordings produced by this background monitor in conjunction with a standard d-c recording milliammeter are shown in Fig. 4. These traces are simple enough for data reduction to be done by office personnel or in the case of legal actions, to be understood by a jury.

An alarm, such as a bell or klaxon, can be operated whenever the background exceeds a predetermined value by a relay in place of or in series with the recorder. The difference amplifier cuts off at count rates slightly exceeding the top mark of the indicating meter to avoid damage to the instrument. The alarm point must therefore be set at a value not much more than 1.5 times maximum meter reading.

Count takeoff can be accomplished not only by a relay in series with the strobe, but also by a subsidiary capacitor at the thyratron plate or by tapping into the a-f circuit. Telemetering of the count is possible using a 600-ohm winding on the audio output transformer with a T attenuator to hold the pulse height within the limits of the transmission line. Because of the slow count rate, a v-u meter here will not give satisfactory results, and a calibrated oscilloscope is recommended for these adjustments.

Varying Range

Ranges other than 100 cpm are easily obtained, as the count rate for top mark on the indicator varies inversely as the capacitance of C_4 through a wide rande of values. Count rates exceeding 10,000 cpm should not be attempted with this type of circuit, however, as this approaches the limit of the pulse equalizer.

For many applications a nonrecording monitor fills all needs. A circuit for such a monitor can be derived from that of Fig. 2 by bridging just ahead of S_1 and omitting all circuits to the right of that point.

Some users prefer an audio system that is silent until the count rate exceeds a given value, such as 80 cpm. Effective control is accomplished by a meter-type relay connected from plate to plate of V_2. Contacts connect a dummy resistor in place of the speaker at low count rates. Because of the low current rating of most meter-type relay contacts, and the relatively high currents present in the audio system, a secondary relay is usually necessary.

The same function can also be accomplished by use of a vtvm-controlled relay, with the grid of the meter input minus resistor connected to the grid terminal of the left section of V_2. This procedure is ideal for alerting to high count rates and eliminates the annoyance of audio noise at low count rates.

Construction of a Geiger background monitor of this type is straight-forward. This unit fits a standard 7- by 8- by 14-in. cabinet containing a 7- by 13- by 3-in. chassis. Chassis brackets were used to give the assembly mechanical rigidity.

To prevent shifting and sagging, all high-wattage fixed resistors are bracket mounted and all large tubular capacitors are mounted in fuse clips on appropriate supports.

Heat is disposed by grouping the tubes at one end of the chassis away from the capacitors and providing convective cooling openings at the back and top of the cabinet.

References

(1) R. L. Ives, Devices for Calibration of Slow-Counting-Rate Meters, *Nucleonics*, **10**, p 64, Oct. 1952.

(2) R. L. Ives, Continuous Recorder Keep-Alive Circuit, ELECTRONICS, **25**, p 161, Nov. 1952.

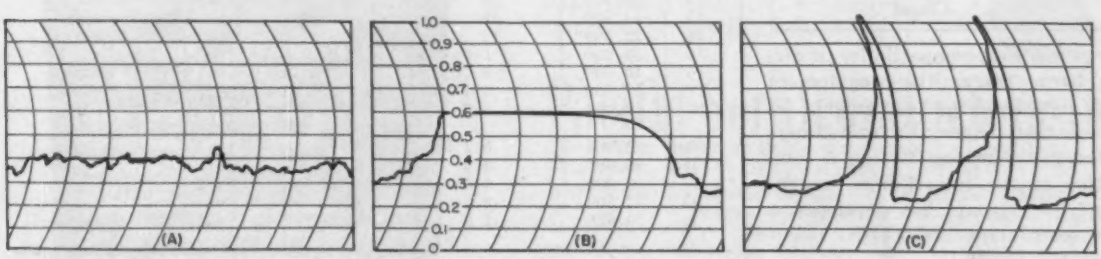


Fig. 4—Recorded radioactivity on scale of 100 cpm. Normal background is shown at (A), calibration check at (B) and passage of two hot loads at (C). Charts provide permanent record for legal and data reduction use

Telemetry Standards for Guided Missiles

With ever-growing demands on the telemetering facilities of government missile test ranges, standardization of equipment characteristics is of prime importance. Here in condensed form are the latest standards for preferred multiplexing equipment, subcarrier frequency allocations and r-f carrier

TABLE I—Subcarrier Bands

Band	Center Frequency (cps)	Max Deviation (percent)	Freq Response (cps)
1	400	±7.5	6
2	560	"	8.4
3	730	"	11
4	960	"	14
5	1,300	"	20
6	1,700	"	25
7	2,300	"	35
8	3,000	"	45
9	3,900	"	59
10	5,400	"	81
11	7,350	"	110
12	10,500	"	160
13	14,500	"	220
14	22,000	"	330
15	30,000	"	450
16	40,000	"	600
17	52,500	"	790
18	70,000	"	1,050
A	22,000	±15	660
B	30,000	"	900
C	40,000	"	1,200
D	52,500	"	1,600
E	70,000	"	2,100

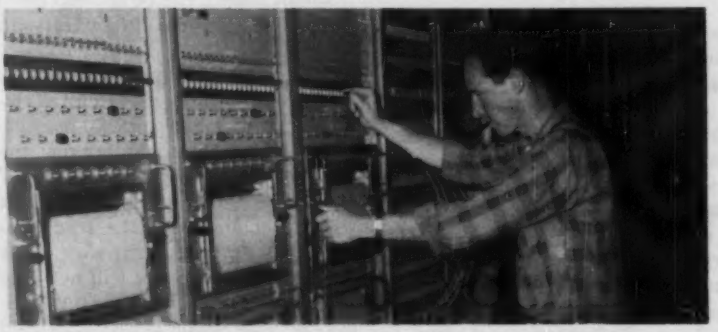
Bands A through E are optional and may be used by omitting adjacent bands as follows:

Band Used	Omit Bands
A	15 and B
B	14, 16, A, and C
C	15, 17, B, and D
D	16, 18, C, and E
E	17 and D

TO PROMOTE compatibility of airborne transmitting equipment and data-handling equipments at missile test ranges, the Inter-Range Telemetry Working Group, a committee of the Inter-Range Instrumentation Group, has developed a new set of standards, IRIG Document No. 103-56.

IRIG is an organization composed

(continued on page 98)



Technician checks bank of data recorders at Point Mugu, California

TABLE II—Commutation Rates (Unseparated Data)

Band	Center Freq (cps)	Sample Duration (millisec)		Commutation Rate* (samples per second)	
		Conservative Values	Minimum Values	Conservative Values	Maximum Values
1	400	670	170	1.5	6
2	560	480	120	2.1	8.4
3	730	370	91	2.7	11
4	960	280	70	3.6	14
5	1,300	210	51	4.9	20
6	1,700	160	39	6.4	25
7	2,300	120	29	8.6	35
8	3,000	89	22	11	45
9	3,900	68	17	15	59
10	5,400	49	12	20	81
11	7,350	36	9.1	28	110
12	10,500	25	6.4	39	160
13	14,500	18	4.6	55	220
14	22,000	12	3	83	330
15	30,000	8.9	2.2	110	450
16	40,000	6.7	1.7	150	600
17	52,500	5.1	1.3	200	790
18	70,000	3.8	0.95	260	1,050
A	22,000	6.1	1.5	170	660
B	30,000	4.4	1.1	230	900
C	40,000	3.3	0.83	300	1,200
D	52,500	2.5	0.63	390	1,600
E	70,000	1.9	0.48	530	2,100

* Frame rate times the number of samples per frame. This assumes no lost time between samples. Multiply this value by the duty cycle for the actual values

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GENERAL PURPOSE	Mil-E-1/1139 (Sig C)
HIGH VOLTAGE	Mil-T-12679 39 (Sig C)

EIA TYPE	Minimum Saturation Voltage (volts) @ 100 μA	Minimum Current Forward @ +1.0v	Maximum Reverse Current (μA) 25°C	Maximum Reverse Current (μA) 100°C	Reverse Recovery Characteristics: Reverse Resistance (ohms)	Reverse Recovery Characteristics: Maximum Recovery Time (μs)
1N663	100	100	5(75v)	50(75v)	200K	0.5
1N662	100	10	1(10v) 20(50v)	20(10v) 100(50v)	100K	0.5
1N643	200	10	.025(10v) 1(100v)	5(10v) 15(100v)	200K	0.3

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Telemetry Standards (continued from page 96)

TABLE III—Commutation Specifications

No. of Samples Per Frame	Frame Rate (Frames per second)	Commutation Rate (Samples per second)	Lowest Recommended Subcarrier Bands cps
18	5	90	14,500
18	10	180	22,000 (±15 percent) or 30,000 (±7.5 percent)
18	25	450	30,000 (±15 percent) or 70,000 (±7.5 percent)
30	2.5	75	10,500
30	5	150	22,000 (±7.5 percent)
30	10	300	22,000 (±15 percent) or 40,000 (±7.5 percent)
30	20	600	40,000 (±15 percent)
30	30	900	70,000 (±15 percent)

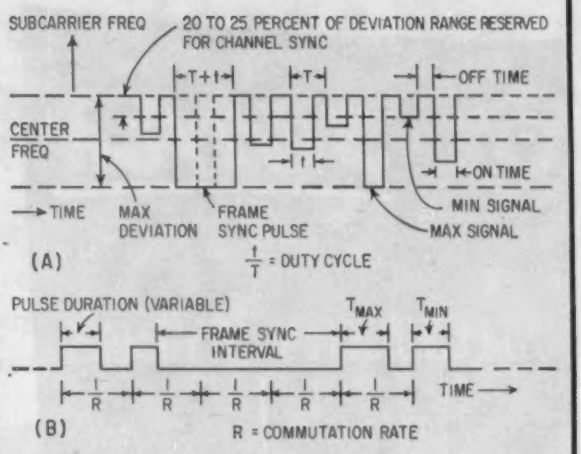


FIG. 1—Automatic commutation pulse pattern (A). Pulse waveform for pulse duration modulation systems should conform to (B)

of representatives of all U. S. missile test ranges of the three military services, and many related government development agencies and aircraft test activities.

Frequency-division Multiplex

Part I of the standards sets forth specifications for telemetry systems of the frequency-division multiplex type.

Eighteen subcarrier-band center frequencies with accompanying information on frequency deviation and nominal intelligence frequency response are specified in Table I.

Commutation

Commutation or time-division multiplexing may be used in one or more subcarrier bands. When automatic decommutation is not used, the data from each demodulated subcarrier shall appear in time sequence. Commutation rates should not exceed the values listed in Table II. The sample durations listed in the conservative value column of Table II apply when the recording equipment is limited to a cutoff frequency equal to the specified frequency response of that subcarrier band as given in Table I.

When automatic decommutation is employed, the samples per frame and frame rates shall conform to Table III. The commutation pattern should be as shown in Fig. 1A. When using airborne gating, the pulse duration t must be within 47 to 53 percent of the nominal period T. If ground gating is employed, the duty cycle shall be between 60 and 75 percent.

Pulse Duration Modulation

The specifications outlined in Table IV apply to either electronic or mechanical commutators. A representation of the pulse waveform is given in Fig. 1B. The relation between pulse duration and information magnitude should be linear. The time interval between leading edges of successive pulses within a frame shall be uniform and constant within 25 μsecs. The frame rate shall not vary more than +5 to −15 percent from nominal.

Radio Frequencies

Specifications pertaining to the r-f carrier and its modulation are shown in Table V. Specific carrier frequency assignments must be obtained by negotiation with the pertinent test range. Appropriate spacing between adjacent r-f channels must be provided.—S.W.

BIBLIOGRAPHY

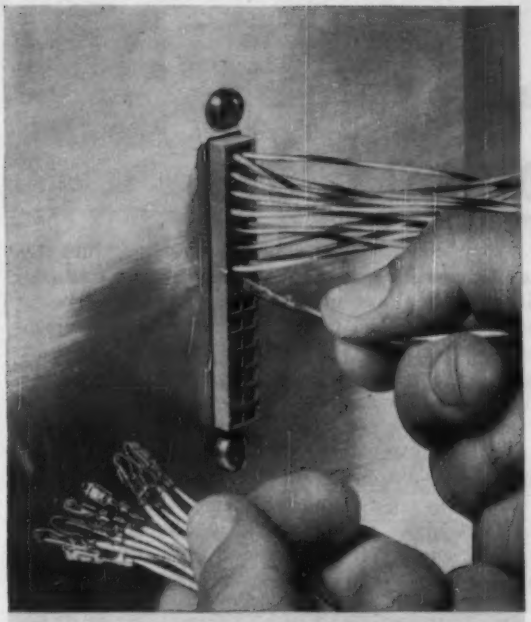
"Telemetry Standards for Guided Missiles", IRIG Document No. 103-56, Oct. 1956.

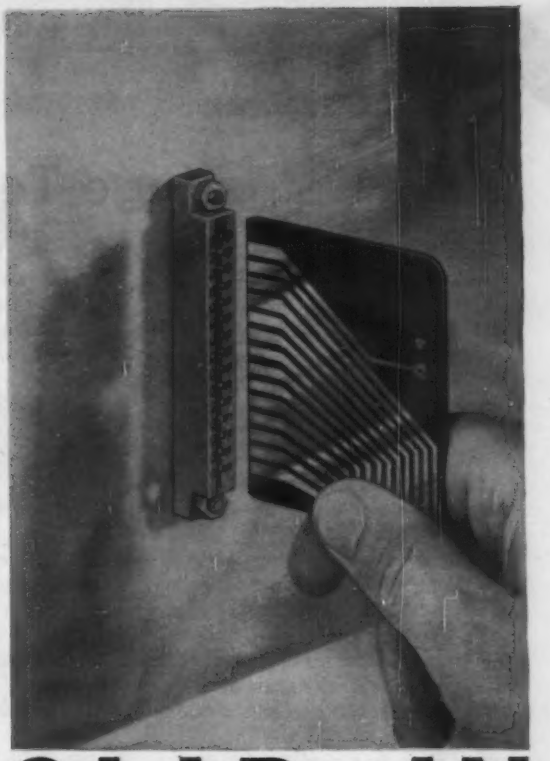
TABLE IV—PDM/FM Standards

No. samples/frame	30	45	60	90
Frame rate, frames/sec	30	20	15	10
Commutation rate, samples/sec	900	900	900	900
Min pulse duration, T_{min}	90 ± 30 μsecs			
Max pulse duration, T_{max}	700 ± 50 μsecs			
Pulse rise and decay times	10 to 20 μsecs (constant to ±3 μsecs)			

TABLE V—R-F Carrier and Modulation Standards

	System Type	
	f-m/f-m or f-m/p-m	pdm/f-m
R-f carrier freq	216 to 235 mc	216 to 235 mc
Carrier stability, percent	±0.01	±0.01
Type of modulation	frequency or phase	frequency
Carrier deviation	±125 kc, max	±25 to ±45 kc
Power	100 w, max	100 w, max
Spurious radiation	>60 db below carrier power	>60 db below carrier power





SNAP IN CLIP IN

THE NEW AMP PRINTED CIRCUIT EDGE CONNECTOR

This A-MP unit is more than new—it is the only *solderless, direct-contact* connector on the market. Designed for both commercial and military requirements, it means faster assembly, greater reliability and versatility to you—at lower cost!

You get construction of unmatched close tolerances in both the contact and the one-piece molded housing. And—because each contact is wholly enclosed within its own housing barriers, there's no need for post insulation. Contacts feature spring-lock design which assures positive contact with board—yet will not cause damage to board paths, even after repeated insertions.

Assembly is easy: An A-MP high speed machine crimps contacts to circuit wires. Contacts are quickly and completely snapped into housing, locked in place with a lance to eliminate damage from shorts, bending or strain. The printed circuit board is then inserted for unlimited circuit combinations.

Snap in . . . clip in—it's that simple to save time, money and increase quality.

Send for full product information today.

AMP INCORPORATED

GENERAL OFFICES: HARRISBURG, PENNSYLVANIA

A-MP products and engineering assistance are available through subsidiary companies in: Canada • England • France • Holland • Japan

New Centrifuge Tests Missile Parts

PRODUCERS of miniaturized, close-tolerance components used in inertial guidance systems sometimes find that elaborate, expensive equipment is required to test them. Future requirements for such components to be used in space vehicles may place even greater demands on the manufacturer.

To prepare for the space age, American Bosch Arma has installed a Genisco centrifuge. It will be used to test a vital inertial guidance component—a new highly accurate accelerometer.

The accelerometer, to be used in the Titan guidance system, can measure accelerations as small as 0.000005 g. It can detect deviations from true course of the missile to better than one part in 500,000.

Accuracy

In accepted practice, test equipment should have an accuracy of ten times that of the components under test. Since such accuracies are not feasible in large rotating machinery, a performance specification of one part in 100,000 of centrifugal force was established. Evaluation tests recently completed demonstrated the ability of the machine to meet this specification.

The boom is a triangular cantilevered beam 20 ft long. The precision end will accommodate a 16-in. cube weighing up to 50 lb. The cube can be subjected to centrifugal forces from 0.25 to 12 g's. Magnitude of the force can be measured within 0.001 percent.

On the opposite end of the boom, called the environmental end, electronic or mechanical test packages weighing up to 400 lb and measuring 3 ft cube can be tested to acceleration forces up to 25 g's.

Drive System

The drive is an eight-pole, three-phase induction-start synchronous motor. Speed control from 6 to 10 rpm required a three-phase power supply variable from 0.4 to 7 cps. Torque demands placed maximum current at about 200 amp.

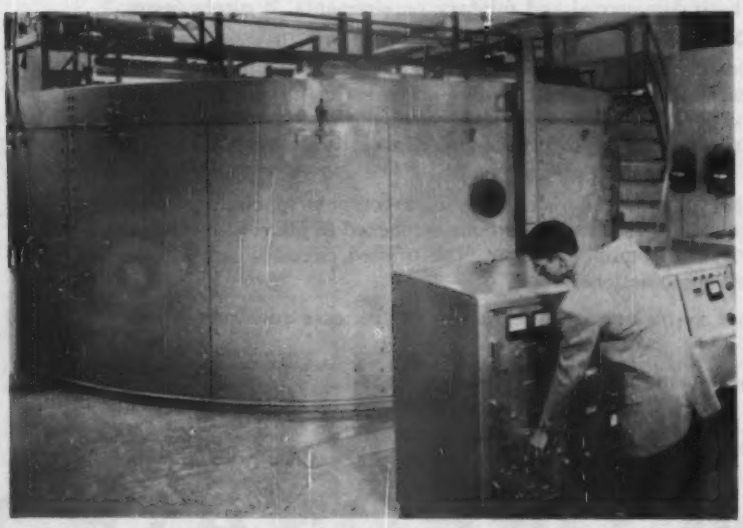
The three-phase oscillator is based on the capacitor-resistor phase-shift network principle. Frequecy is varied by a precision 3-gang potentiometer. Since the unit requires maximum temperature stability, it is enclosed in a heavy copper heat sink box and sunk below floor level in the temperature-controlled machine enclosure.

A mechanical extension to a handwheel at the control console permits accurate speed settings by elapsed time per revolution as read on an electronic 8-decade counter.

Amplification of the output signal from the oscillator is accomplished through specially designed equipment consisting of precision power supplies, automatic bias control systems, and separate amplifiers for each of the three phases.

Very low frequencies behave more like direct than alternating current, and most large-capacity power amplifiers are not practical. Final amplification up to 200 amp is done through three electromechanical rotary amplifiers.

Speed indications are provided by an aircraft tachometer system to an accuracy of one percent, a 600 pulse/revolution pickoff for intermediate accuracies up to 0.1 percent and, for accuracies up to one part per million, an electronic counter that measures elapsed time per revolution (or multiples of revolutions).



Silo houses centrifuge used to test highly accurate accelerometers to be used in Titan inertial guidance system. Engineer takes readings and controls motion of centrifuge from master console. Specialized electronic measuring equipment and high speed counters provide the readings

Power Meter Protects Microwave Workers

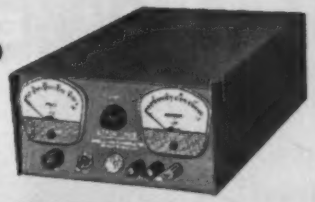
PLANTS developing high-power microwave equipment are confronted with a personnel safety and comfort problem. Knowledge of system characteristics do not enable prediction of microwave effects because of near-field distortion, reflections, side lobes or leakage.

Development of a portable power-density meter for survey of high-energy fields near powerful microwave devices was announced by Sperry Microwave Electronics Co., division of Sperry Rand Corp.

The new device now in produc-

VRPS Kepco for the most complete line of POWER SUPPLIES

REGULATION and STABILITY 0.1%



Model SC-18-2-M

*Two units mounted in Rack Adapter RA-2

Model SC-18-4-M

*VOLTAGE REGULATED POWER SUPPLIES

MODEL	OUTPUT VOLTS DC	OUTPUT AMPERES DC	OUTPUT IMPEDANCE DC-1KC	OUTPUT IMPEDANCE 1KC-100KC	SIZE W	SIZE H	SIZE D
SC-18-0.5	0-18	0-0.5	.04	.4	8¼"	4⅞"	13⅝"
SC-18-1	0-18	0-1	.02	.2	8¼"	4⅞"	13⅝"
SC-18-2	0-18	0-2	.01	.1	8¼"	4⅞"	13⅝"
SC-18-4	0-18	0-4	.005	.05	19"	3½"	13"
SC-36-0.5	0-36	0-0.5	.08	.8	8¼"	4⅞"	13⅝"
SC-36-1	0-36	0-1	.04	.4	8¼"	4⅞"	13⅝"
SC-36-2	0-36	0-2	.02	.2	19"	3½"	13"
SC-3672-0.5	36-72	0-0.5	.15	1.0	8¼"	4⅞"	13⅝"
SC-3672-1	36-72	0-1	.08	.8	19"	3½"	13"

Patent Pending

(TUBELESS)

TRANSISTORIZED

SHORT CIRCUIT PROTECTED

- **REGULATION:** 0.1% for line changes 105-125 volts at any output voltage in the range minimum to maximum.

  0.1% or 0.003 volt for load changes 0 to maximum (whichever is greater) at any output voltage in the range minimum to maximum.
- **RIPPLE:** 1 mv. RMS.
- **RECOVERY TIME:** 50 microseconds.
- **STABILITY:** (for 8 hours) 0.1% or 0.003 volt (whichever is greater).
- **AMBIENT OPERATING TEMPERATURE:** 50°C maximum. Over-temperature protection provided. Unit turns off when over-temperature occurs. Power-on-off switch on front panel resets unit.
- **TEMPERATURE COEFFICIENT:** Output voltage changes less than 0.05% per °C.
- **SHORT CIRCUIT PROTECTION:** No fuses, circuit breakers or relays! Designed to operate continuously into a short circuit. Returns instantly to operating voltage when overload is removed. Ideal for lighting lamps and charging capacitive loads.
- **OVER-CURRENT CONTROL:** Can be set from 0 to 120% of full load. Current is limited to preset value for any load including short circuit.
- **REMOTE PROGRAMMING** at 1000 ohms per volt is provided. Remote programming allows mounting a voltage control at a remote point.
- **REMOTE ERROR SIGNAL SENSING** is provided to maintain stated regulation directly at load.
- **CONSTANT CURRENT OPERATION:** These units can be set up for constant current operation without internal modification.
- **POWER REQUIREMENTS:** 105-125 volts, 50-65 cycles. 400 cycle units available.
- **OUTPUT TERMINATIONS:** DC terminals are clearly marked on the front panel. All terminals are isolated from the chassis. Either positive or negative terminal of each DC output may be grounded. A terminal is provided for connecting to the chassis. The DC terminals, the remote programming terminals and the remote error signal sensing terminals are brought out at the rear of the unit.
- **CONTROLS:** Power-on-off switch, one turn voltage control, on front panel. Over-current control on rear of unit. Ten turn voltage control available on special order.
- Continuously Variable Output Voltage. No voltage switching.
- Suitable for square wave pulsed loading.
- Either positive or negative can be grounded.
- Units can be series connected.
- High efficiency
- Low heat dissipation.
- Compact, light weight
- For bench or rack use.
- Color: Gray hammertone. (Special finishes available).

ORDERING INFORMATION:

Units without meters use model numbers indicated in table. To include meters add M to the Model No. (e.g. SC-18-1-M).

*Rack adapter for mounting any two 8¼" x 4⅞" units is available. Model No. RA2 is 5¼" high 19" wide.

*Rack adapter for mounting any one 8¼" x 4⅞" unit is available. Model No. RA3 is 5¼" high 19" wide.

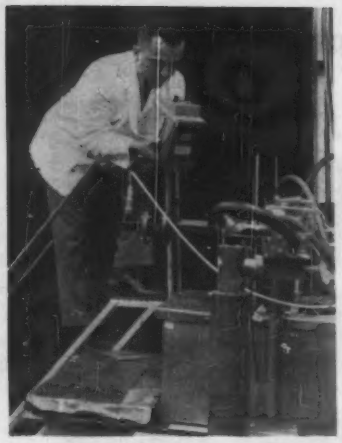
AN 0.01% SERIES IS AVAILABLE IN 13 NEW MODELS

KEPCO OFFERS MORE THAN 120 STANDARD VOLTAGE REGULATED POWER SUPPLIES COVERING A WIDE RANGE OF MAGNETIC, TUBE AND TRANSISTOR TYPES. MOST MODELS AVAILABLE FROM STOCK. SEND FOR BROCHURE B-587

KEPCO LABORATORIES, INC.

131-38 SANFORD AVENUE • FLUSHING 55, N.Y.

INDEPENDENCE 1-7000



Radar specialist uses microwave power-density meter to survey a radar lab. Because of new multimegawatt radar developments at Sperry labs, meter was developed to explore concentrations of microwave energy

tion is a simplified search meter. It directly measures power density of high-level microwave fields. It was designed to replace involved bench-type power meter setups heretofore carried on test carts.

The new unit is specifically designed for detecting hot spots and leakage areas around antennas, transmitter tubes and plumbing. It gives a continuous direct reading of true power density in mw/sq cm with an accuracy of −0, +2 db. The meter is also scaled in db relative to 10 mw/sq cm, the presently accepted physiological reference level for microwave power fields.

The unit was developed to conform with a USAF Tech Order establishing maximum power density levels permissible in working areas containing operating radar equipment. The sensitivity of the meter's measurement exceeds power level standards set by the Air Force.

The meter is currently being produced in three standard types to cover frequencies in S, C and X bands. Each type is self calibrating and operated by internal mercury batteries. Total weight of the heaviest meter is six lb, including batteries.

A single-knob operating control combines on-off switch and zero adjustment, permitting operation by nontechnical personnel.

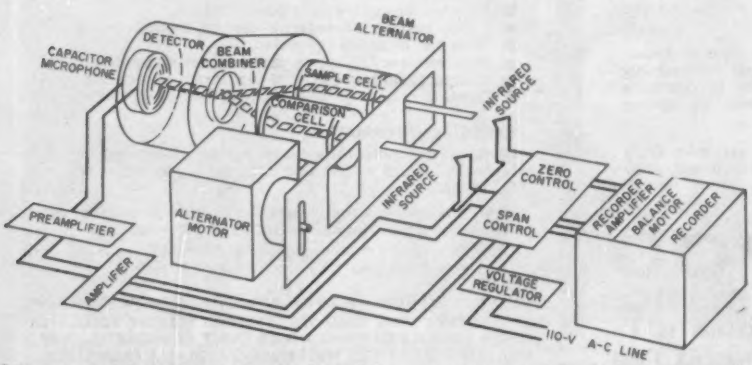
Infrared Controls Production

ELECTRONIC infrared analyzers are being used in the production of synthetic ammonia.

In a number of recently constructed plants, ammonia is being produced by partial oxidation of natural or refinery gas. These gases have a high concentration of methane.

Methane concentration in this process is an indication of reaction efficiency. Therefore, knowing the concentration enables operators to adjust the process for changes in temperature or in methane content of the raw gas.

Analysis of methane presented a problem, since the gas stream is dirty and contains steam at high pressure. Infrared analyzers are performing this function successfully at the Mississippi River Fuel



Infrared absorbed by gas in sample cell is compared to that from comparison cell. Gas in detector expands and contracts according to amount of infrared, producing signal in capacitor microphone

FLIGHT DATA and CONTROL ENGINEERS

Cross new frontiers in system electronics at The Garrett Corporation.

High-level assignments in the design and development of system electronics are available for engineers in the following specialties:

1. ELECTRONIC AND FLIGHT DATA SYSTEMS AND CONTROLS A wide choice of opportunities exists for creative R & D engineers having specialized experience with control devices such as: transducers, flight data computers, Mach sensors, servo-mechanisms, circuit and analog computer designs utilizing transistors, magamps and vacuum tubes.

2. SERVO-MECHANISMS AND ELECTRO-MAGNETICS Requires engineers with experience or academic training in the advanced design, development and application of magamp inductors and transformers.

3. FLIGHT INSTRUMENTS AND TRANSDUCERS

1) DESIGN ANALYSIS Requires engineers capable of performance analysis throughout preliminary design with ability to prepare and coordinate related proposals.

2) DEVELOPMENT Requires engineers skilled with the analysis and synthesis of dynamic systems including design of miniature mechanisms in which low friction freedom from vibration effects and compensation of thermo expansion are important.

4. PROPOSAL AND QUALTEST ENGINEER For specification review, proposal and qualtest analysis and report writing assignments. Three years electronic, electrical or mechanical experience required.

Forward resume to:
Mr. G. D. Bradley

THE GARRETT CORPORATION
9851 S. Sepulveda Blvd.
Los Angeles 45, Calif.

DIVISIONS:
AiResearch Manufacturing—Los Angeles
AiResearch Manufacturing—Phoenix
AiResearch Industrial
Rex • Aero Engineering
Airsupply • Air Cruisers
AiResearch Aviation Service

CIRCLE 61 READERS SERVICE CARD

AiResearch centralized air data computing system...

on Navy's new McDonnell F4H-1

...supplying the following major airplane subsystems: Autopilot, Air Induction, Armament Control, Navigation, Surface Controls, Cockpit Indication and Pneumatic Static Pressure Correction.

The AiResearch centralized air data computing system integrates pneumatic, electronic, electrical and mechanical components on one of the Navy's fastest jets. It senses, measures, and automatically corrects all air parameters affecting flight. It supplies air data information to the pilot and all major airplane subsystems.

This centralized combination of transducers, computers and indicators is the most complete air data computing system ever devised. It enables aircraft to operate at maximum efficiency continuously.

Eliminating duplication of components, the AiResearch centralized air data computing system cuts down space and weight requirements over decentralized systems by many times. Its principal functions: angle of attack, true static pressure (electrical and pneumatic), true air speed, true Mach, altitude, rate of climb, total temperature, dynamic pressure and altitude and Mach error.

AiResearch has been the leader in the development of centralized computing systems. The F4H-1 installation is the first, single package air data computer possessing completely interchangeable, modular construction.

Your inquiries are invited.

ENGINEERING REPRESENTATIVES: AIRSUPPLY AND AERO ENGINEERING, OFFICES IN MAJOR CITIES

THE GARRETT CORPORATION

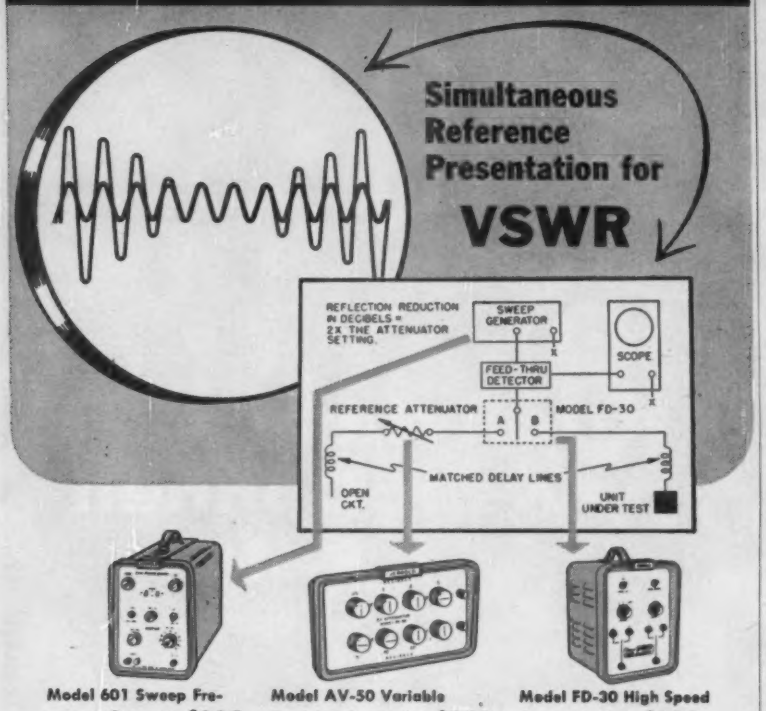
AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Systems, Packages and Components for: AIRCRAFT, MISSILE, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

JERROLD

ACHIEVES A NEW STANDARD OF ACCURACY IN RF Measurements by Comparison



Model 601 Sweep Frequency Generator $395

Model AV-50 Variable Precision Attenuator $150

Model FD-30 High Speed Coaxial Switch $250

Equipment shown provides test set up for measurements from 12 to 225 mcs. Other equipment available from 15 kc to 1200 mcs, sweep widths up to 400 mcs.

Measurements Unaffected By:

1. Variations of oscilloscope gain or linearity
2. Variation of generator output
3. Square law characteristics of detector
4. Delay line losses

SEND FOR TECHNICAL NEWSLETTER

Fully illustrated — describes test set ups for measuring Gain, Losses, and VSWR.

Jerrold Electronics Corporation
Dept. TED 26
Gentlemen: Please send me Technical Bulletin on MBC procedures.

Name _____ Title _____

Company _____

Address _____

JERROLD **ELECTRONICS CORPORATION**
The Jerrold Building, 15th and Lehigh
Philadelphia 32, Pa.

Jerrold Electronics Corp., Ltd., Toronto, Canada • Export—Rocke International, New York, New York

Corp. ammonia plant at Selma, Mo. A special sampling system was constructed for this installation by Mine Safety Appliances Co.

The sampling system cools the sample, removes the resulting condensate, filters the gas and reduces pressure.

Infrared Analyzer

Nichrome heated to about 1,300 F furnishes two sources of infrared. The beams are directed into a sample and a comparison cell, converged in a beam combiner and directed into a detector. A shutter alternately blocks each beam, permitting comparison of the amount of light reaching the detector through the two cells.

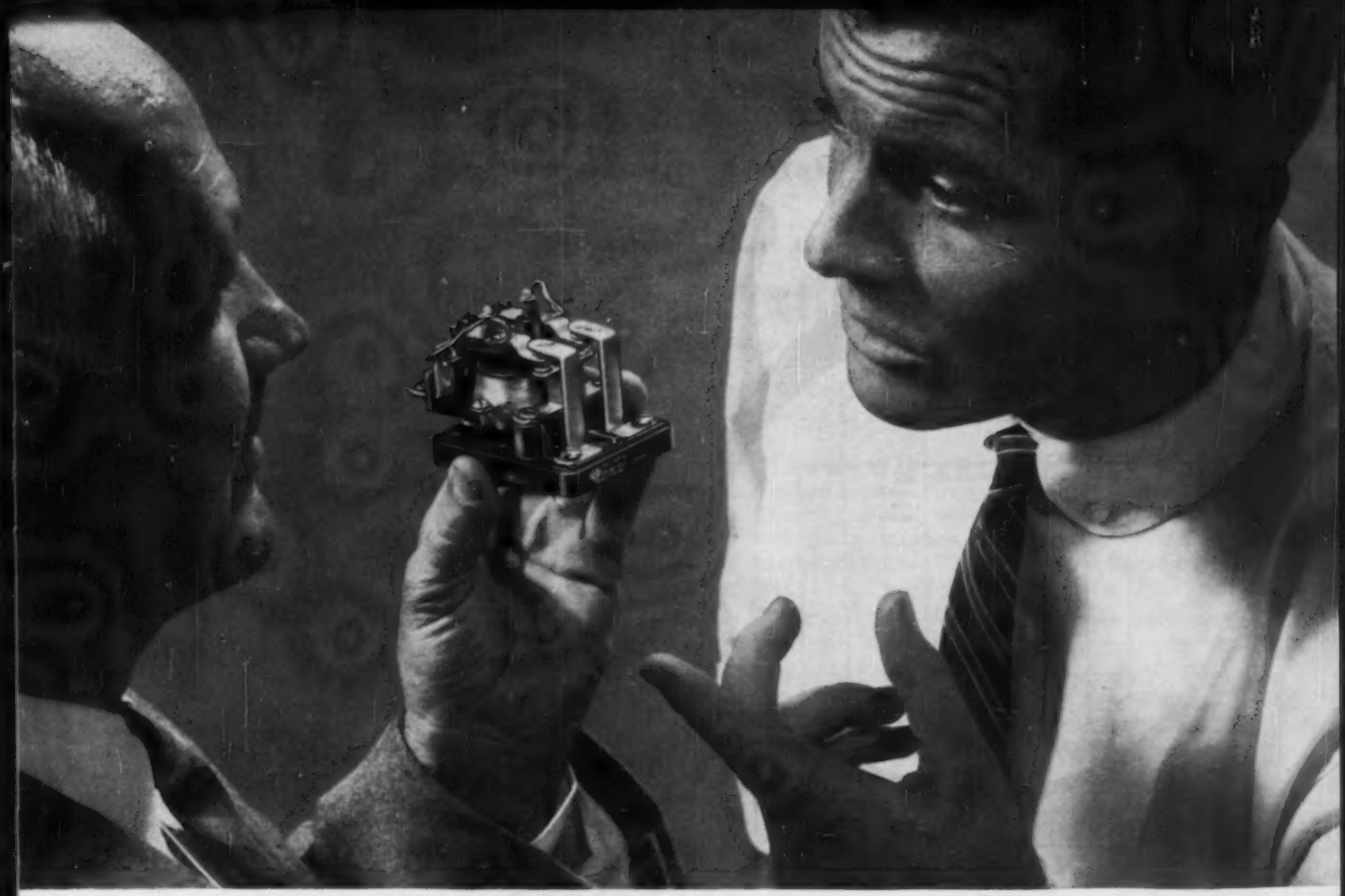
Initially, the same amount of light reaches the detector through both cells. The comparison cell is sealed and used as a reference. The gas is introduced into the sample cell. If the gas absorbs infrared, the amount of light reaching the detector through the sample cell is reduced.

An expansion chamber in the detector cell is filled with the same kind of gas that is to be measured. The gas in the chamber, which is sensitive to infrared, expands when it is exposed to a certain frequency of infrared and contracts when the infrared is reduced.

A small diaphragm (actually one plate of a capacitor microphone) is mounted above the chamber. As the beams are switched between sample and comparison cells, expansion and contraction results when light through the two cells is unequal. Hence a signal is produced in the microphone proportional to the difference in gas concentration in the sample and comparison cells. Microphone output is fed to the amplifier and recorder.

Transistor Tester for Quality Control

NEW PRODUCTION tester for transistors went into operation this week at Sperry Gyroscope Division of Sperry Rand, Lake Success, N. Y. The instrument will be used for acceptance testing of transistors received from vendors. It can test as many as 3,000 transistors in a seven-hour day.



HERE'S WHY P&B's PR POWER RELAY IS PREFERRED

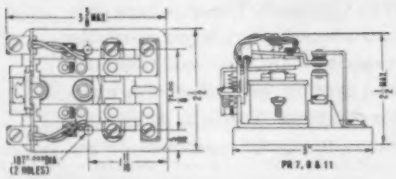
for high current/voltage switching

HEAVY DUTY construction means long-term dependability when switching up to 20 amperes (double break contacts). Here is a ruggedly built relay, packed with high quality features, yet economically priced.

The PR's full floating movable contact carrier, for example, provides excellent contact pressure and ample wipe for self-cleaning contact action. The coil is centrifugally impregnated with top-grade varnish to eliminate moisture traps.

Contact arrangements up to DPDT are available. The PR has been adapted for printed circuitry and heavy duty plug-in applications.

All standard AC actuated PR relays may carry the UL and Canadian Standards Association seals of approval. Write or call for complete information.



PR 7, 8 & 11

GENERAL SPECIFICATIONS:
Breakdown Voltage: 1500 volts rms min. between all elements and ground.
Ambient Temperature: DC: —55° to +85°C.
AC: —55° to +55°C.
Terminals: Heavy duty screw type. Standard printed circuit pins or plug-in on request.
Enclosures: PR dust cover.

CONTACTS:
Arrangements: Up to 2 Form C (DPDT).
Material: 5/16" dia. silver or silver cadmium oxide. (Others available)
Load: Single break: 15 amps; Double break: 20 amps at 115 volts 60 cycle AC resistive.

AUXILIARY CONTACTS:
Arrangements: 1 Form A, B or C.
Material: 3/16" diameter silver
Rating: 5 amps at 115 volts 60 cycle AC resistive.

COILS:
Resistance: 64,000 ohms maximum.
Power: 1.8 watts DC; 9.8 volt-amps AC.
Duty: Continuous AC or DC (DC coils will withstand 10 watts at 25°C).
Insulation: Centrifugally impregnated with high quality varnish.
Mountings: 2 holes .187" diameter 1⅞" o.c.

PR Relays Approved By Underwriters' Laboratories and Canadian Standards Association

Type	Contact Arrangement*	Type	Contact Arrangement*
PR1AY	SPST-NO	PR5AY	SPDT
PR2AY	SPST-NC	PR7AY	DPST-NO
PR3AY	SPDT-NO-DM	PR8AY	DPST-NC
PR4AY	SPDT-NC-DB	PR11AY	DPDT

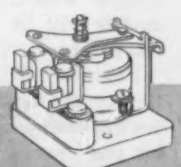
These relays are available in any of the following operating voltages: 6, 12, 24, 48, 115, 208, 230, or 440 volts 50/60 cycles AC.

The contacts are rated at: 13 amps, 115 volts AC. 6.5 amps, 230 volts AC. 1 hp for 115 or 230 volt AC motors.

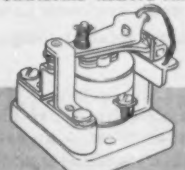
Any relays deviating electrically or physically from these standard models will not carry U/L or CSA approval.

*Read: NO normally open, NC normally closed, DB double break, DM double make.

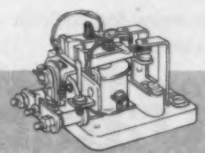
P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR



PR RELAY WITH MAGNETIC BLOW-OUTS
Models PR3 and PR7 can be supplied with alnico magnets to suppress arcs on DC loads over 1200 watts.



SINGLE POLE DOUBLE THROW VERSION
PR 5 (SPDT) has all the heavy-duty features of other models in this series.



PR WITH AUXILIARY CONTACTS
All PR models can be equipped with auxiliary contacts in 1 Form A, B, or C arrangements.

POTTER & BRUMFIELD INC.

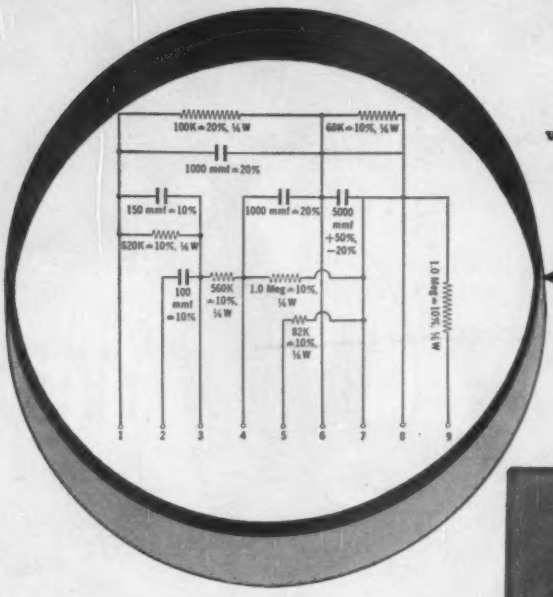
PRINCETON, INDIANA • SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY

CRAMPED FOR SPACE?

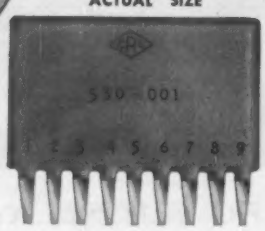
Component Density
221,000 per cubic foot
in Centralab.

PEC*

vs. 55,000 per cu. ft. with conventional components



ACTUAL SIZE



This complex circuit is produced in its entirety in the unit shown here actual size. This almost unbelievable component density is achieved routinely by Centralab. The same basic component/cu. ft. ratio can be maintained where larger or smaller numbers of resistors and capacitors are involved. Centralab PEC* circuits are your most sensible way to achieve ultra-miniaturization with superior reliability. You gain many other advantages by using PEC* circuits in your equipment design.

- **Reduces assembly costs and weight**
- **Eliminates wiring errors and testing**
- **Simplifies inventory and purchasing procedures**
- **Frequently costs less than individual components**

A PEC* circuit can be designed to incorporate capacitors (printed or attached), resistors (fixed or variable) plus inductors, sockets and other components. They are supplied with plug-in terminals for printed wiring or wire leads for metal chassis.

For the best solution to your miniaturization and assembly problems, contact Centralab's packaged circuit engineers now . . . or write for Bulletin 42-227 containing detailed design information.

Centralab*
*Trademark
Y-5831

A DIVISION OF GLOBE-UNION, INC.
914K E. KEEFE AVE. • MILWAUKEE 1, WIS.
In Canada: 804 Mt. Pleasant Rd. • Toronto, Ontario

VARIABLE RESISTORS • SWITCHES • PACKAGED ELECTRONIC CIRCUITS
CERAMIC CAPACITORS • ENGINEERED CERAMICS • SEMI-CONDUCTOR PRODUCTS

The tester checks four parameters: d-c beta, a-c beta, saturation and leakage. It has seven test positions since some parameters are checked in several ways. It requires only one operator for both operating the tester and loading it. Automatic loading provisions can be built in if desired.

The tester, a product of Stromberg-Carlson Co., division of General Dynamics, can be used by transistor manufacturers for grading their product as well as by equipment manufacturers for acceptance sampling. It incorporates a temperature chamber in which transistor parameters may be checked.

Tape Controls Cut Model-Making Time

AIRCRAFT and missile wind-tunnel models are being built with tape-controlled machines, instead of by hand. Engineers say the technique will slash 90 percent off the model lead time from drawing board to wind tunnel testing.

First product of the method is a one-twentieth scale model wing for an F-106 all-weather jet interceptor. It was produced by the aerodynamic and numerical control groups at Convair-San Diego.

The wing model was created with a digital computer, a numerical control director and a Giddings & Lewis profiler. The profiler is a horizontal mill capable of cutting materials in compound curves in three axes, according to instructions on a magnetic tape.

Time Savings

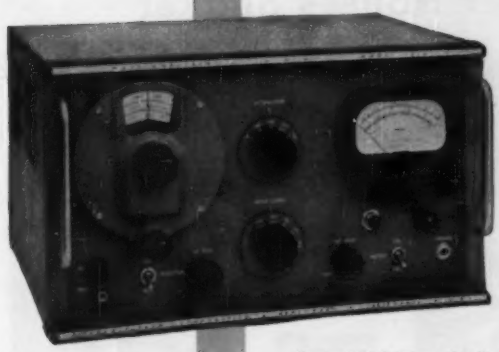
Formerly, 2,000 hours were involved in an average project such as the wing model. Now, it requires 200 hours or less. Reduced model manufacturing time is expected to permit an accelerated aerodynamic study and accumulation of more extensive wind-tunnel data, because models will be so much easier to manufacture.

Engineers will be able to process 10 changes on aircraft or missile designs in the same period required for one change under the present system.

Starting with drawings, engineers calculated formulas to be fed

Fast, convenient, dependable

precision wave analyzers frequency-selective voltmeters



Sierra 121A Wave Analyzer

Sierra now offers exactly the instruments you need for wave analysis, wire carrier and microwave subcarrier applications.

Sierra 121A Wave Analyzer is a highly selective, double superheterodyne receiver covering frequencies from 15 KC to 500 KC and providing wave analysis data directly in voltage and dbm at 600 ohms. The instrument offers the selectivity required for use with new single sideband carrier systems.

Sierra 158A Wave Analyzer is similar but covers frequencies from 500 KC to 10 MC.

Both analyzers have high selectivity, accuracy of ± 2 db, spurious response at least 50 db down, and a signal-measurement range of 77.5 μv to 97.5 volts. The instruments are supplied in cabinet mountings which are readily adaptable to relay rack mounting.

SPECIFICATIONS — SIERRA VOLTMETERS

Model	Frequency Range—kc	Selectivity		Accuracy		Direct Reading in dbm	
		Down 3db	Down 45db	Frequency	Measuring	Balanced	Unbalanced
101C	20-500	± 550 cps	± 2900 cps	Note A	± 3 db	Note D	600 ohms
103B†	3- 40	± 400 cps	± 3000 cps	± 0.5 kc	± 3 db	Note D	600 ohms
104A	5-150	± 300 cps	± 1500 cps	± 1 kc	± 3 db	Note D	600 ohms
108B	15-500	± 550 cps	± 2900 cps	± 3 kc Note B	± 2 db Note C	135 ohms Note D	600 ohms
114A	100-800	± 550 cps	± 2900 cps	Note A	± 3 db	Note D	600 ohms

All Sierra Carrier Frequency Voltmeters feature built-in calibration oscillators and circuits for level calibration, have aural monitoring jacks, and (except 103B) are furnished with Sierra Model 149A Precision Spiral Scale Dials.

† Contains carrier re-insertion oscillator for monitoring suppressed carrier systems. Furnished with planetary drive dial. Note A. Ranges from ± 2 KC at low end of dial to ± 3 KC at upper end. Note B. ± 1 KC in the 48 KC to 256 KC region. Note C. ± 1 db for + 30 db to — 40 db attenuator steps on 135 ohm balanced measurements. Note D. All models may be converted for 135 and 600 ohm balanced line measurements by convenient plug-in bridging transformer, Model 130D.

Sierra 101C Carrier Frequency Voltmeter

For carrier system and other field or laboratory work between 3 kc and 800 kc, Sierra offers 5 accurate, stable, tuned vacuum tube voltmeters. All are direct reading in voltage and dbm at 600 ohms from —80 dbm to +42 dbm.

Line Bridging Transformer

Model 130D Dual Impedance Line Bridging Transformer converts VTVM and wave analyzer inputs from single-ended to balanced operation. Covers 3 kc to 500 kc, bridges both 135 and 600 ohm balanced lines.

Impedance Meter, Line Fault Analyzer

Sierra 166 Impedance Meter (at left) measures impedance on high noise circuits, 30 kc to 300 kc; measures on "hot" lines through coupling capacitor.

Sierra 124 Line Fault Analyzer pinpoints shorts, opens or grounds on open wire lines. Direct reading, range ½ to 200 miles, accuracy ¼ mile.

Data subject to change without notice.

sierra

Sierra Electronic Corporation

A Subsidiary of Philco Corporation

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CIRCLE 67 READERS SERVICE CARD

to the computer. From resulting data, run through the numerical director unit onto magnetic tape, numerical control engineers reproduced in one unit the upper and lower surfaces of new F-106 wing.

Normally, model work in metal is accomplished through the use of templates—working each section of the wing or fuselage over and over with electric grinders and hand files.

Test Chamber Houses Shaker

Plant improvement plan underway at Stromberg-Carlson includes installation of walk-in environmental test chamber. It can accommodate large vibration machine for environmental testing of military electronic equipment over temperature range from — 120 to 350 F, humidity from 20 to 95 percent and altitudes up to 100,000 ft

Vibration Unit Tests Instruments

VIBRATION effects on instruments for aircraft and missiles are being studied at U. S. Gauge using newly installed test facilities. Design engineers can now test their developmental models under carefully controlled laboratory conditions. They can analyze the specific effects of severe vibration conditions and develop designs that withstand these conditions.

The new test equipment can produce vibration frequencies up to 6,000 cps and amplitudes up to 55 g's. In addition, ambient temperatures can be controlled from —80 to 500 F.

U. S. Gauge designers point out that performance specifications for newer aircraft have become increasingly severe as a result of the natural trend toward increased power to weight ratios. Instruments designed to withstand vibration amplitudes of 5 g's at frequencies up to 55 cps must be completely redesigned to perform satisfactorily when subjected to vibrations of higher amplitude and frequency, as encountered in jet or rocket-propelled craft. Moreover, cut and try methods of obtaining improved performance are prohibitively expensive and time consuming.

Basic element of the new vibration equipment is a liquid-cooled vibration exciter. This is a pedestal style unit and contains the test instrument or component mounted on its top. It has a force rating of 1750 lb at vibrational frequencies up to 6,000 cps.

The exciter is operated through an adjacent control console and an electronic amplifier, which is located some 115 ft away in another building. The amplifier, remotely operated from the console, has a rating of 15 kva and a power input of 75 kw. By knob adjustments at

the console, the operator can set the equipment to automatically control the vibration output over any desired frequency range and at any vibration amplitude.

To observe effects of extreme vibration and temperature environments, engineers use a high-intensity stroboscopic light with an automatic synchronizer. This creates a slow-motion effect at any vibrational frequency. Therefore, by means of a stereomicroscope with 10X magnification, the designer can observe and measure relative motions between component parts of the instrument undergoing test. Certain undesirable and unpredictable motions occur at definite frequencies. The engineers must know what these motions are before they can make design corrections.

Modern Test Chamber Is Installed

STRATOSPHERE chamber, installed in Raytheon's new 5,800 sq-ft environmental test building, will be used to test the radar used in the B-58 Hustler bomber. The new facility is the first section of an 80,000 sq-ft electronics laboratory.

Designed to approximate climatic conditions through which the Hustler will fly, the stratosphere chamber is 7 ft wide, 8 ft high and 10 ft deep. Temperatures can vary from −100 to 300 F, pressures to about 100,000 ft in space and humidity from 20 to 98 percent.

Equipment being tested can be viewed from outside the chamber through special windows, eight glass panels thick.

Vibration tests can be run under any of the chamber's climatic conditions. The chamber is specially reinforced and is mounted on a 56-ton concrete base resting on thick rubber pads to prevent vibration damage to the rest of the building.

Test facilities in the new Sudbury building also include two acoustically conditioned rooms for vibration tests. These are built with 12-in. thick walls lined with 3-in. insulating material.

Other facilities include salt spray acoustic test areas and provision for additional stratosphere and humidity chambers.

Good-All
CAPACITORS

Two thoroughbreds and a workhorse!

SPACE SAVER

Good-All Type 663 UW SPACE-SAVING Sub-Miniature with a SKIN-TIGHT Case

Type 663UW is an ideal choice for miniaturized and transistorized products. The space-saving possibilities are amazing.

SPECIFICATIONS		Voltage Range	100–600 VDC
Dielectric	Mylar Film	Temp. Range	−55° to +125°C
Case	Plastic Wrap	IR at 25°C	100,000 Meg. x Mfd.
End Fill	Thermo-Setting Plastic	Humidity Resistance	Superior

HIGH TEMP.

GOOD-ALL Types 616 G and 617 G Sub-Miniature Metal Enclosed Mylar* Designs

Designed to provide EXTENDED LIFE at high temperatures. Rugged, military construction throughout. These lines include a 50-volt series for transistor applications.

SPECIFICATIONS		Temp. Range	Full rating to 125°C, 50% derating at 150°C
Dielectric	Mylar Film		
Case	Hermetically Sealed	D.C. Voltage Rating	50, 150, 400 and 600
Winding	Extended Foil		

BROAD USAGE

METAL ENCLOSED Tubulars per MIL-C-25A

The "workhorse" of military electronics. Good-All specializes in Types CP04, CP05, CP08, CP09, CP10 and CP11. Approvals are listed by ASESA in the current issue of the QPL.

*DuPont's trademark for polyester film.

A LEADING MANUFACTURER OF TUBULAR, CERAMIC DISC AND ELECTROLYTIC CAPACITORS

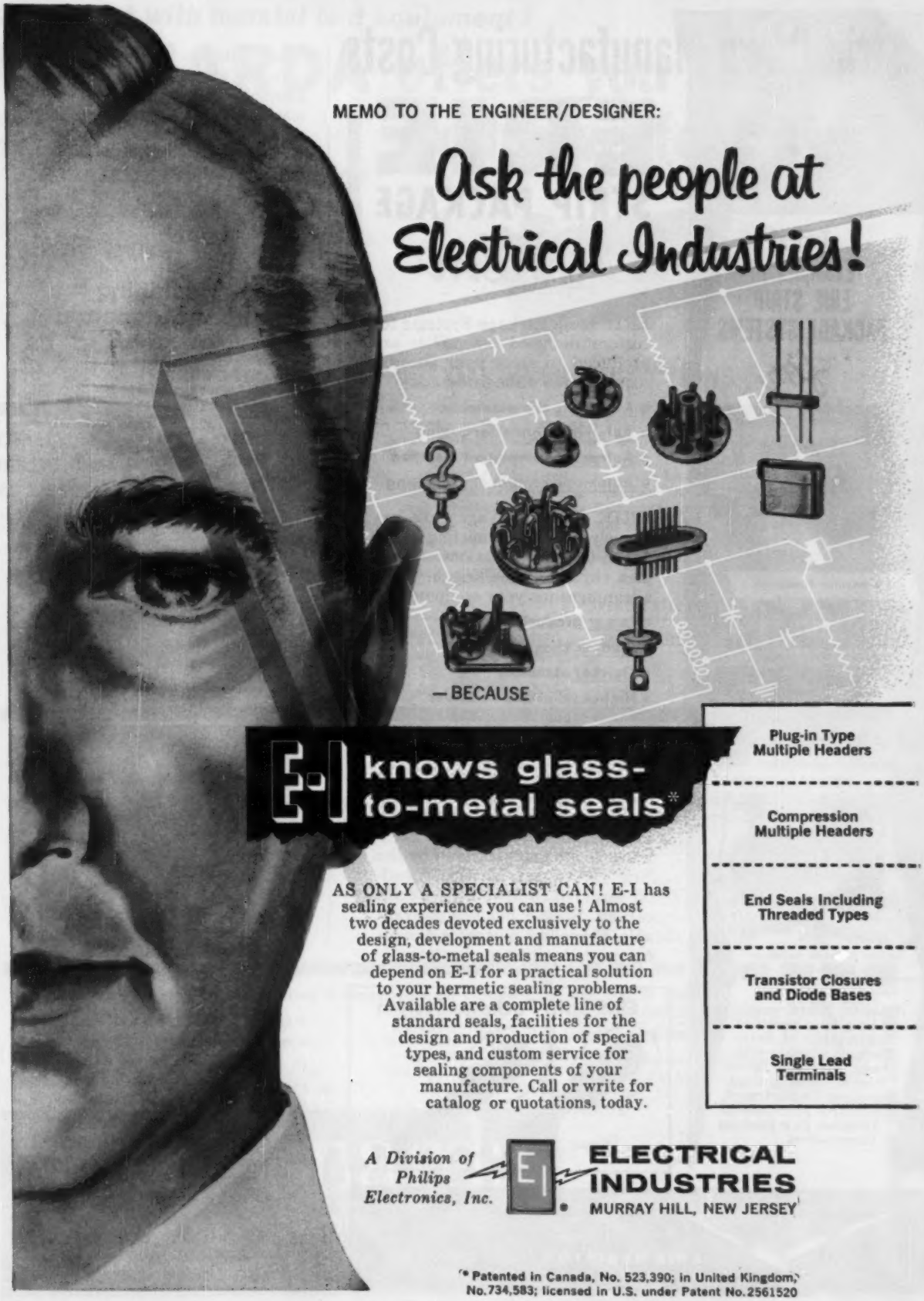
GOOD-ALL ELECTRIC MFG. CO.
OGALLALA, NEBRASKA

Modern Semiconductor Manufacture

FLEXIBILITY is the keynote in Texas Instrument's new semiconductor-components plant in Dallas. Well aware of the rapid changes in production often necessitated by introduction of new components, the firm has set up its facility so that production changeovers can be accommodated rapidly and easily.

The four accompanying illustrations highlight some of the important manufacturing areas located in the 150,000-sq-ft second floor of the new plant. Starting at the upper left and progressing clockwise, the silicon and germanium crystal-growing department is shown first. Next is a silicon-diode multiposition sealing machine located in a "Snow-White" air-conditioned manufacturing area. Third, a computer-device assembly room illustrates how the Snow-White area is enclosed and separated from other areas. The final illustration shows a production-line setup for germanium-transistor final assembly.

The Snow-White area covers 60,000 sq ft and is sealed off from the rest of the plant by glass and masonry walls. Electronically filtered air is kept at a constant temperature and at 20-percent relative humidity. Smoking is not allowed and all persons entering the area pass through a negative pressure air lock, wear lint-free clothing and walk over a special shoe-



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- Transistor Closures and Diode Bases
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ELECTRICAL INDUSTRIES
MURRAY HILL, NEW JERSEY

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Strip Down Manufacturing Costs

with the...

ERIE STRIP PACKAGE *system*

ERIE Strip Package Systems for custom designed assemblies are produced to meet your specific requirements while featuring:

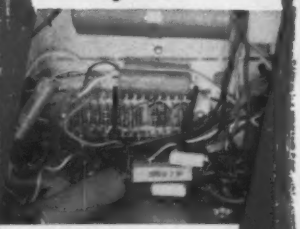
- **Automatic** clip assembly
- **Automatic** connector cutting
- **Automatic** component insertion
- **Automatic** component soldering

ERIE Strip Packages are extremely flexible, permitting adaptation to many variations of complex circuitry, resulting in these advantages for your equipment:

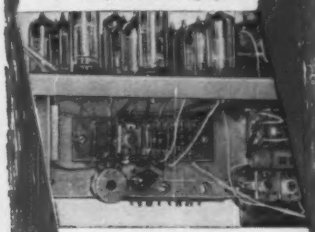
- **Lower** production costs
- **Cleaner** chassis
- **Quicker** assembly
- **Higher** reliability in solder connections
- **Easier** servicing

ERIE supplies the customer's complete component package. Many electronic components used in the production of the Strip Package are manufactured by the Erie Electronics Division. Lead-off wires cut to customer's specifications. Special mountings available. Erie offers pluggable designs for printed wiring applications.

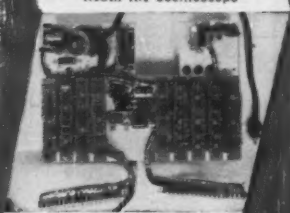
Typical Examples of ERIE STRIP PACKAGE SYSTEMS for



V-M Amplifier Phonograph



Heath Kit Oscilloscope



Packard Radiation Instrument Chassis

Consult ERIE engineering for a practical application of Strip Package in your equipment. For more information, write to Engineering Department, Electro-Mechanical Division, Erie Resistor Corporation.

ERIE Strip Package System

ERIE RESISTOR CORPORATION

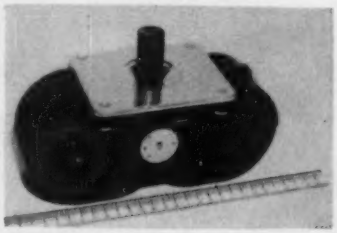
MAIN OFFICES ERIE, PA. U.S.A. FACTORIES ERIE, PA. • HAWTHORNE, CALIF.

cleaning device.

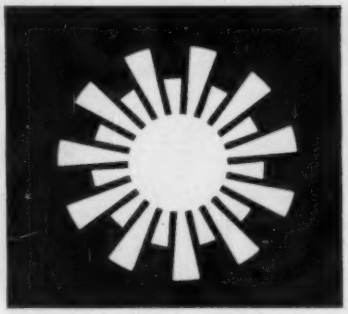
In the final stages of transistor assembly, less moisture can be tolerated than in the Snow-White areas. Glass dry boxes are used. Workers pass gloved hands through two holes in the boxes and complete transistor assembly in an atmosphere with less than 12-percent relative humidity.

Spark Machining Produces Magnetron

By **YOSHITAKA KIYOTA,**
Tool Section,
TADAKUNI FUJII,
Research Laboratory,
KIYOSHI UCHIMARU,
Electron Tube Industry Div.,
and **KAZUO AYAKI,**
Research Laboratory,
Nippon Electric Co., Ltd., Tokyo, Japan



External view of magnetron



Anode block silhouette

FABRICATION of the anode block for a new pulsed magnetron operating in the 34.8 kmc band is accomplished with electrical-discharge machining. Although the technique itself is not new (see this issue, p 90), application to magnetron manufacturing is unconventional.

The tube was designed by determining important tube parameters directly at the operating frequency. This is in contrast to the more common practice of scaling from an original model designed

Concerned with coaxial test equipment?

Only NARDA offers you these exclusive features!

TURRET ATTENUATORS

Only Narda offers you a UHF-only attenuator. This represents a considerable savings in cost for applications in this frequency range. Each of three models offers the Designer or Development Engineer 12 steps of attenuation from d.c. to 1,500 mc with a VSWR of 1.25. Designed for bench use or mounting into test equipment packages.

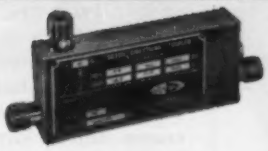
One unit can give a maximum of 30 db attenuation; two units can be used in series to provide a wide range of control in small steps.

Model 705—0, 3, 6, 9, 12, 15, 20, 25, 30 db
Model 706—0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20 db
Model 707—0, 3, 6, 9, 12, 15, 18, 21, INF db
Model 708—0, 5, 10, 15, 20, 25, 30, 35, 40, INF db

MODELS from **$275**

COAXIAL DIRECTIONAL COUPLERS

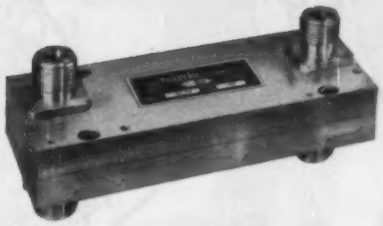
10, 20 and 30 DB . . . 225 to 10,000 mc.



Only Narda offers coaxial directional couplers in 10 and 30 db values, as well as 20 db. In addition, all models offer such advantages as these:

1. Flat Coupling—values with 1 db of nominal over a full octave frequency range, with calibration provided to ± 0.2 db accuracy.
2. Machined from solid blocks of aluminum—hence, more rugged.
3. Directivity exceeding 20 db.
4. Frequency Ranges: 225-460, 460-950, 950-2000, 2000-4000, 4000-10,000, mc.

$100 to **$150**



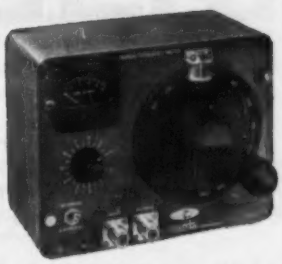
COAXIAL HYBRID JUNCTIONS

For use in duplexers, mixers, and other circuits requiring a division of power into two transmission lines. A signal into any terminal appears at the two opposite terminals. Both are equal in amplitude, but one is shifted 90 degrees in phase.

Input and output terminals are in line, permitting operation of TR tubes between a pair of hybrids. Type "N" female terminals are standard, but other types are available on request. Ruggedized construction safeguards against shock and vibration; will also withstand severe atmospheric conditions. Three models cover frequencies of 460-950, 950-2000, 2000-4000 (mc), all with 3.0 db coupling, ±0.25. VSWR: 1.2. Isolation: 20 db.

SPECIFICATIONS

Band	Frequency (mc)	NARDA Model	Coupling (db)	VSWR	Isolation (db)	Size (excl. conn)	Price
—	460-950	3031	3.0 ± 0.25	1.2	20	10½x2½x⅞	$225
L	950-2000	3032	3.0 ± 0.25	1.2	20	6½x2½x⅞	225
S	2000-4000	3033	3.0 ± 0.25	1.2	20	5x2½x⅞	225



UHF FREQUENCY METER DETECTORS . . . Direct Reading

The only direct reading frequency meter detectors available for the UHF range—and they're from Narda, of course! Absorption type meters, with 0.2 db insertion loss, each includes a resonant cavity, coaxial switch, crystal detector, current meter, sensitivity control and type N terminals.

SPECIFICATIONS

Frequency (mc)	Accuracy	Loaded Q	VSWR	Sensitivity for full scale deflection	NARDA Model	Price
200-500	0.5 mc	500	1.15	0.2 mw	804	$375
500-1500	1 mc	700	1.15	0.2 mw	805	375
1500-2400	2 mc	500	1.25	0.5 mw	806	375

Complete Coaxial and Waveguide Instrumentation for Microwave and UHF — including:

DIRECTIONAL COUPLERS
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COAXIAL HYBRIDS
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STANDARD REFLECTIONS
BOLOMETERS
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200 to 90,000 mc.

the narda microwave corporation

118-160 HERRICKS ROAD, MINEOLA, L. I., N. Y. • PIONEER 6-4650

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Dept. E-9

NAME_____

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ADDRESS_____

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—and now for the heat test!

So you *did* build your own pot! Now — will it function at 150°C? It *might*, if you made sure to use some real cool winding wire (say, with no more than 20 parts per million temperature coefficient)! A specially-designed heat-resistant element card would also be handy to keep things cool! But you don't *have* to build-'em-yourself and then go through all this barbecue-broil testing, to be assured of pots with good high-temperature characteristics!

Why take "pot luck", when Ace *has* all these special high-temperature design features — neatly packaged in the Acepot X-500! Our exclusive design dissipates internal heat to the mounts, allowing greater dissipation at high temperature. So put away your chef's hat — and rely on Ace's four years of testing. For high temperature performance — the X-500's your answer. See your ACErep!

The X-500 Acepot. From −55°, up to 150°C, with special heat-resistant elements. Excellent resolution, ±0.3% linearity. ½" size, ¼-ounce. Prompt delivery.

ACE ELECTRONICS ASSOCIATES, INC.
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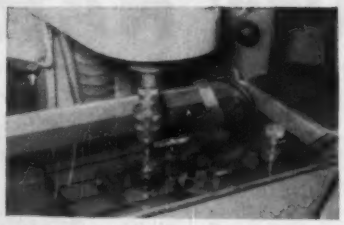

Electrical discharge machine

for lower-frequency operation.

A 22-vaned copper anode block was chosen for the LD 443 magnetron. The block to be machined and a brass tool constitute the anode and cathode, respectively. The two electrodes are immersed in kerosene or distilled water. A direct voltage of about 100 v is applied between the two. When the tool is brought close to the block, electrical discharge occurs between the electrodes and a part of the copper block melts and is dissipated. Distance between the two electrodes depends upon the materials of the two, the processing fluid and the applied voltage. But it is usually about a few microns.

Features of electrical discharge machining in this application include: no pressure is applied to the block to be machined, the finished block has high mechanical precision, the tool can be made of brass, and highly skilled workers are not required since the tool feed mechanism is servo controlled.

Typical operating characteristics for the new tube are as follows: operating frequency, ±1 percent of 34.860 kmc; peak power output, 45

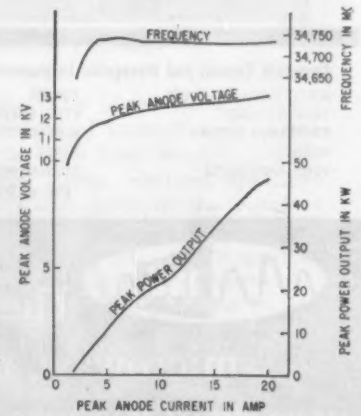

FIG. 1—Operating characteristics of the new pulsed magnetron

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An Important New Addition to B&A's line of "Electronic Grade" Chemicals

B&A supplies ingots of intrinsic or first reduction metal individually wrapped in polyethylene, six to a corrugated shipping box. Germanium dioxide is packaged in standard screw-cap bottles.

B&A Special High Purity

GERMANIUM

Dioxide **First Reduction Metal** **Intrinsic Metal**

Now Baker & Adamson offers the electronic industry a dependable, domestic source for high purity germanium and germanium dioxide—part of America's leading line of electronic chemicals.

You get all these advantages with B&A Germanium:

Dependable, domestic source: Why rely on uncertain foreign sources for this key raw material when B&A has it—*domestically produced, always readily available!* By using B&A as your source for both raw material and scrap reclaiming you can cut inventory requirements, effect other economies.

Lower volatile! B&A Germanium Dioxide contains about 0.5% less volatile than many other oxides . . . will thus yield about 0.5% more metal when reduced.

Dustless! B&A Germanium Dioxide is free from fine particles. Dust losses, often a problem, are sharply reduced.

Higher bulk density! The bulk density of B&A Germanium Dioxide is 60% to 70% higher than many other oxides. Therefore the boats which carry oxide through the reducing furnace will yield about 60% more metal for each furnace pass.

Save on scrap tolls! B&A can handle all grades of scrap with lower toll charges on low assay material.

Investigate all these advantages of B&A Germanium *now*. Call your nearest B&A sales office.

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"Electronic Grade" Chemicals

Allied Chemical

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A single stage magnetic computer amplifier having exceptionally high gain

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Three stage low null drift stabilized magnetic amplifier

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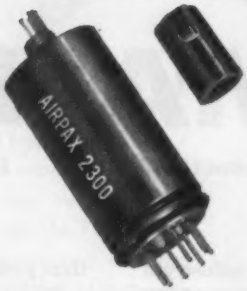
All electronic speed measurement device permits tachometry with 0.1% accuracy—simple, inexpensive



LOW NOISE CHOPPERS

Series 2300 for 400 CPS
Series 2400 for 60 CPS

The CONTACT MODULATOR

PART I of the new series of booklets on the CONTACT MODULATOR is just off the press. Send for your free copy.

AIRPAX

L 4

CAMBRIDGE, MARYLAND — BALTIMORE, MARYLAND

THE AIRPAX PRODUCTS COMPANY

FORT LAUDERDALE, FLORIDA

Finished copper block (left) and brass tool (right)

kw; peak anode voltage, 13 kv; peak anode current, 20 amp; pulse width, 0.2 μsec; prr, 1,000 pps; duty ratio, 0.0002. A permanent magnet yields a flux density of 12,500 gausses for the gap distance of 5 mm. Operating frequency, peak anode voltage and peak power output versus peak anode current are shown in Fig. 1.

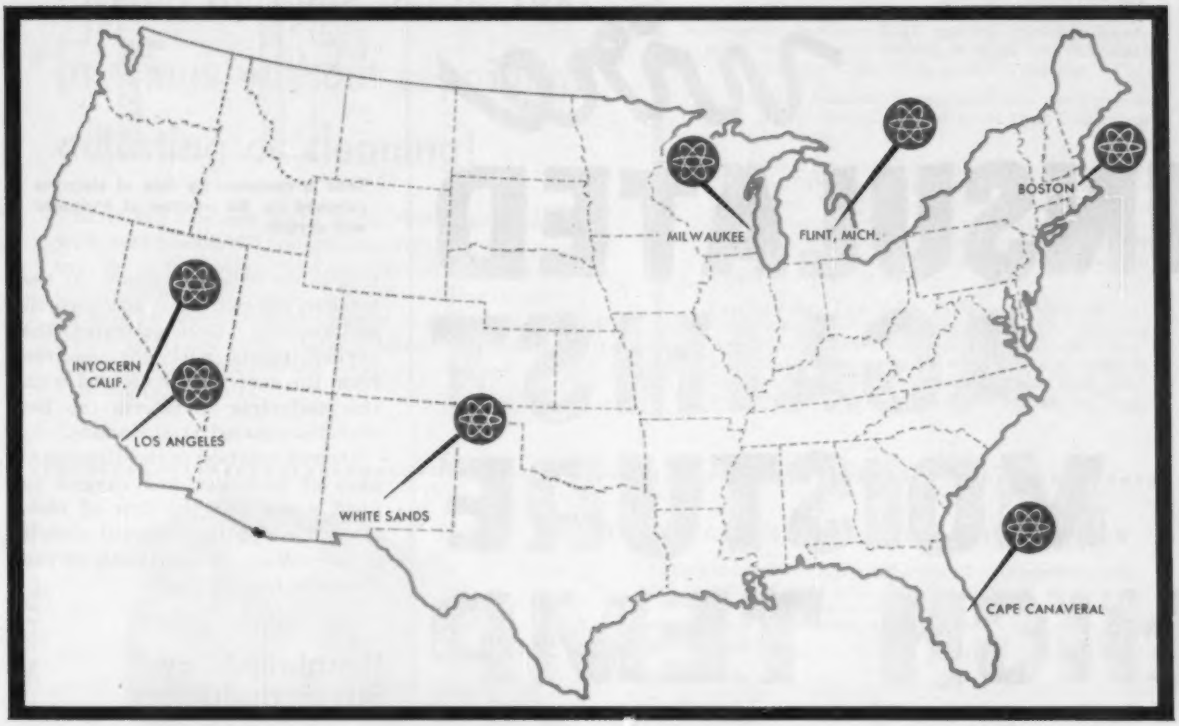
Gaseous Fuel Cell Has High Efficiency

CHEMICAL ENERGY obtained from an external source is converted instantaneously into electrical energy by a device known as a gaseous fuel cell. In the accompanying illustration, two 15-watt light bulbs are illuminated by the energy from the cell. High efficiency, up to 90 percent, results from the fact that there is no intermediate process of conversion from chemical energy to heat energy.

In the fuel cell developed by Allis-Chalmers Mfg. Co., Milwaukee, Wis., hydrogen gas is adsorbed onto the catalyst at the anode. It is activated and reacts with an ion in the electrolyte, releasing an elec-

Two 15-watt light bulbs are illuminated by direct conversion of chemical energy to electrical energy by fuel cell

How far can an engineer go at AC?



Flint, Michigan; Milwaukee, Wisconsin; Boston, Massachusetts; Los Angeles, California—original design and development.

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Just as far as his talents, imagination and initiative will take him. He can go across the country or around the world. He can go even to top management positions. As a matter of fact, some of General Motors' Vice Presidents have come from the ranks of AC.

His career—or your career—can go up with missiles and futuristic space vehicles. For AC is building more and more of one of the world's leading inertial guidance systems—the AChiever—plus a wide variety of other electro-mechanical, optical and infra-red devices.

You can exploit your talents to the fullest degree at AC. For every AC engineer has access to the finest equipment . . . at all AC facilities.

Meanwhile, you can work on advanced degrees to enhance your professional status. AC and General Motors gladly assist further study in the first-rate engineering schools located in nearby locations.

It's doubtful whether a graduate engineer in the electronic, electrical or mechanical fields can find more diverse opportunities . . . or more challenging assignments . . . or greater professional status . . . than engineers enjoy at AC-Milwaukee.

If you are a qualified engineer, you should talk with the people at AC. Just write the Director of Scientific and Professional Employment: Mr. Robert Allen, Dept. A., Oak Creek Plant, Corner of Drexel and Howell, Milwaukee, Wisconsin; or Mr. M. Levett, Dept. A., 1300 North Dort Highway, Flint 2, Michigan.

It may be the most important letter of your life.

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AC SPARK PLUG ⊛ THE ELECTRONICS DIVISION OF GENERAL MOTORS

ELECTRONIC *wire* INSULATED AGAINST MOISTURE HIGH TEMP ABRASION

all types conforming to **SPECIFICATION MIL-W-16878B**

Within the wide range of insulated electronic wires . . . conforming to Specification Mil-W-16878B . . . Continental offers every type and size. Insulations in polyvinyl . . . Teflon . . . Silicone Rubber . . . and Nylon . . . assure a Continental wire to Mil-W-16878B specifications for practically every electronic operation where moisture, high and low temperatures, and corrosion present their problems.

Whether from stock or to *your* special order, Continental insulated wire is quality engineered to precise specifications. For help with your insulated wire requirements, write today. Be sure to give details on amperage, voltage, diameter limitations, and operating temperatures.

Direct all inquiries to CONTINENTAL WIRE, Wallingford.

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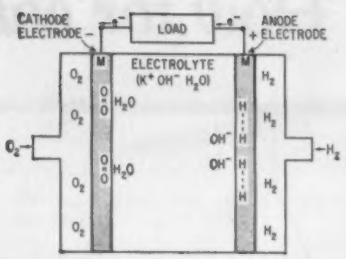


Load is energized by flow of electrons released by the reaction of hydrogen and oxygen

tron to the external circuit. At the cathode, oxygen gas is adsorbed simultaneously. Once activated, the oxygen reacts with the electron from the external circuit and with the electrolyte to reform the ion that disappeared at the anode.

Overall reaction is the disappearance of hydrogen and oxygen to yield water and the flow of electrons through the external circuit at the voltage characteristic of the chemical reaction.

Uranium-Alloy Superconductors

FOUR new superconductors—devices characterized by ability to permit an electric-current flow in them to flow indefinitely—have been discovered at the Westinghouse Research Laboratories.

The new superconductors are all intermetallic compounds. They are alloys of uranium and one other metal. Two of them contain manganese and iron, elements that have been considered alien to the existence of superconductivity.

Electron Devices Meeting Next Week

NEXT week's Electron Devices Meeting in Washington (Oct. 30 and 31) at the Shoreham Hotel will include technical sessions on semiconductor devices and techniques, microwaves, tubes and tube technology, storage tubes, electron panel devices and cathode and tube theory.

An opening general session will present four papers on the subjects of controlled fusion, *p-n* junctions, panel display devices, and parametric amplifiers.

VICTOR DIGIT-MATIC PRINTERS

Proved by over 16,000,000 printings without repairing, adjusting or cleaning!

The adding machine in the Digit-Matic has been tested with over 16,000,000 continuous printings, with no failure, no service other than periodic oiling. Forty years of experience in producing 1,500,000 adding machines—as well as precision instruments such as the Norden Bombsight—has given Victor Adding Machine Co. outstanding qualifications for producing rugged and reliable digital printers.

CHECK THESE 4 VICTOR ADVANTAGES

Reliability: Examine the rugged construction of a Victor machine. Each part is conservatively designed to provide extended life and reliability. Wearing surfaces heat treated, cyanide hardened to stand up under constant use. All steel parts cadmium plated to prevent rusting.

Immediate Service: Factory-trained servicemen (and parts) are on call in more than 725 cities coast to coast.

Flexibility: At least 500,000 different combinations available, with speeds up to 33 characters per second. With Victor Digit-Matics you have your choice of listers, accumulators, or calculators *plus* an almost infinite number of other variations ranging from electrical noise filters to upside-down printing.

Fast Delivery, Low Price: Because of Victor's continuous high volume of adding machine production, we can ship almost any quantity of Digit-Matics—built specifically to your order—within 30 days. Victor Digit-Matics, from only $425.00, are the value buy in the digital printer field.

VICTOR SERIAL ENTRY DIGIT-MATIC PRINTER

10 Digit solenoids. Digits are entered in sequence with most significant digit first. Accepts digits at a rate up to 20 per second. Print cycle: listers 0.27 seconds; accumulators 0.35 seconds. Available in up to 11 column entry capacity.

COIL DATA

Voltage	21-28VDC	42-54VDC	125-160VDC
Resistance, ohms			
Digit solenoid	25.5	75.0	490.
+ or − Print solenoid	25.5	75.0	450.
Minimum on time, seconds	.02	.02	.02
Maximum on time, seconds (continuous printing)	.05	.05	.05

Minimum off time between digits—all serial entry machines—.025 seconds.

COVER REMOVED

VICTOR PARALLEL ENTRY DIGIT-MATIC PRINTER

All digits 1 through 9 of each column equipped with solenoids. Digit and print command solenoids may be simultaneously energized. Print cycle:—listers 0.30 seconds; accumulators 0.35 seconds. Available in up to 10 columns entry capacity.

COIL DATA

Voltage	20-28VDC	35-56VDC	125-160VDC	105-125VAC
Resistance, ohms				
Digit solenoid	17.6	53.0	700.	125.
+ Print solenoid	17.6	89.0	375.	125.
− Print solenoid	17.6	53.0	375.	125.
Minimum on time, seconds	.020	.020	.015	.025
Maximum on time, seconds (continuous printing)	.050	.050	.035	.050

A few popular model variations:—columnar spacing; right side of machine accumulating and left side listing data identification; Non-Add printing; Non-printing adding; MIL-I-17623 Electrical Motor Noise elimination; Induction Motors; Manual Keys over the solenoids; "digit key depressed" switch (serial entry Digit-Matics); tag and label printing; and all kinds of alphabetic and special types.

Write today! Victor's electronics-trained staff will gladly help you solve any digital printing or calculating problem.

Write for technical manual No. A10-71

Electronics Division

VICTOR ADDING MACHINE CO.

3900 N. Rockwell Street, Chicago 18, Ill.

PLAN '59

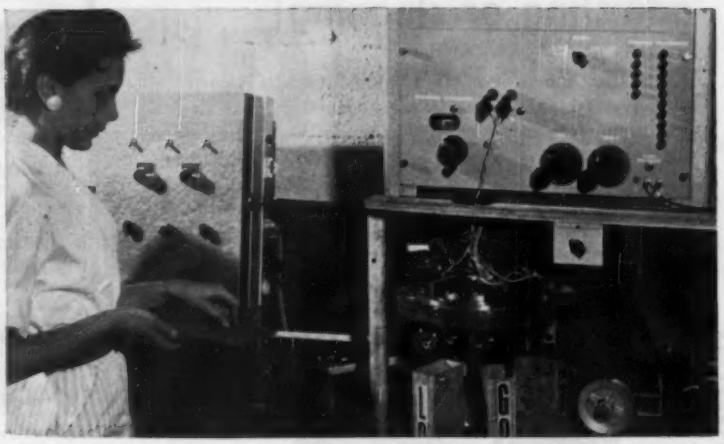
PRODUCTION TECHNIQUES

Tester Sorts Capacitor Plates

By WILLIAM LONDELL, Gulton Industries, Inc., Metuchen, N. J.

AUTOMATIC CAPACITOR plate tester and sorter was developed to allow ceramic plate testing at the speed of automatic manufacturing equipment. The testor sorts plates into good, high and low categories at rates up to 25,000 plates an hour (as many as 3 production workers can test in 8 hours) in tolerances as close as 1 percent of nominal.

The equipment will test units from 0.1- to 1-in. square without mechanical adjustments. All operations are automatic except loading and unloading. Batch size depends on plate thickness. Average loading interval for plates 0.1-in. thick is 10 min. Testing and sorting are simultaneous.



Ceramic capacitor plates are loaded onto paper belt lining V trough. Capacitor value and tolerance are set on automatic limit bridge

How it Works

In operation, the 1 mc automatic limit bridge is set for desired capacitance and tolerance. The plates are loaded into a feed trough, a metal V six feet long. A dual paper belt riding in the trough carries the plates to the pickup point. Paper is used for the belt because it is low cost and free of bumps, slippery or oily spots. As the belt is discarded after one use, it is not a continuous loop. One roll lasts a month.

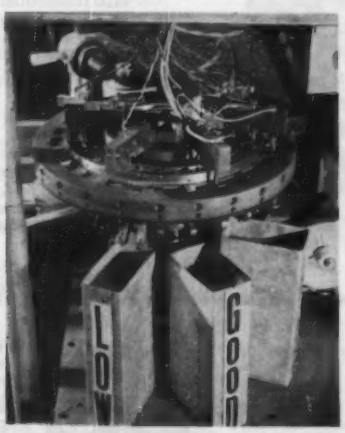
The belt is pulled by an electronically controlled motor. Its speed is determined by plate thickness and by a photocell which will speed up the feed if no plates are present at the pickup point.

Vacuum picks up the plates from the belt. A vertical plate, with 24 equally spaced holes on its circumference, rotates clockwise against a stationary plate which has a channel for the pickup vacuum. The channel is designed so that the vacuum is triggered directly at the pickup point and turned off at the transfer point, top dead center.

Vacuum is also used to transfer the ceramic plate to a contact on the horizontally rotating head. The vacuum shuts off after the head rotates 45 degrees. During this traverse, the lower contact arm is mechanically moved into position to locate the plate in the fixture.

Two sets of contact brushes on top of the head measure plate capacitance. The brushes are spaced so that only one set makes contact at a time. Flexible, small wires in the brushes provide a low-resistance connection. The first set determines if a plate is in the fixture and if its capacitance is high. The second checks plate tolerance.

Belt pulls plates to vacuum pickup. Paper is most economical belt material



Brushes transfer signals from bridge to plate-holding contacts

Sorting

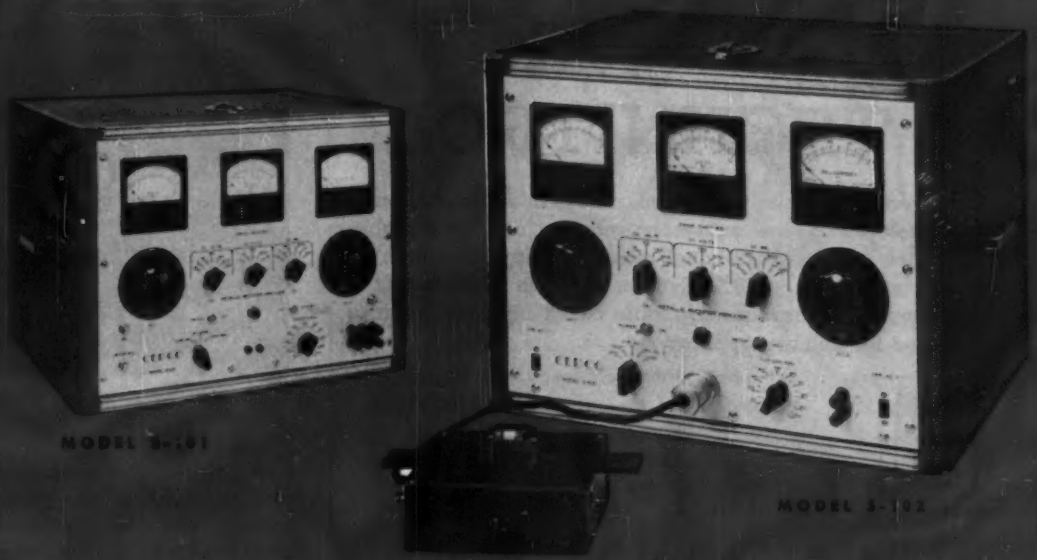
A plate with capacitance higher than the bridge setting will be dropped into the high bin at the first position. If no plate is present, the fixture will be shorted; the bridge sees it as a high plate and drops the contact arm. Plates that pass the first position will drop into the good bin at the second position if tolerance is acceptable. A plate with low capacitance passes both positions and is dropped at

NOW-

RAPID ACCURATE TESTING OF

SILICON
GERMANIUM
SELENIUM

RECTIFIERS and DIODES



MODEL S-101

MODEL S-102

WITH THE NEW Cedco METALLIC RECTIFIER ANALYZERS

FEATURING

5 STANDARD CIRCUIT TESTS

1. **Visual dynamic voltage-current characteristic.**
2. **Dynamic reverse-current leakage.**
3. **Dynamic forward-voltage drop.**
4. **Static reverse-current leakage.**
5. **Static forward-voltage drop.**

NOW . . . for the first time, production and laboratory users of power rectifiers and signal diodes may perform *five* standard circuit tests with *one* precision instrument . . . the CEDCO Metallic Rectifier Analyzer.

Versatile, accurate and rapid, the new CEDCO Analyzer exceeds the highest standards of engineering quality. Three Weston meters, accurate within 1%, AC Voltmeter (0 to 1500 V.), DC Voltmeter (0 to 1000 V.) and DC Milliammeter (0 to 10 AMP.) assure dependable performance.

Model S-101—Self-contained featuring complete set of plug-in adapters, accepting wide range of sizes.

Model S-102—Ideal for laboratory use. Adjustable test fixture for remote testing permits shelf mounting away from the working area.

Illustrated brochure, Bulletin R-250, is available upon request.

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DESIGNERS AND MANUFACTURERS OF PRECISION ELECTRONIC TEST EQUIPMENT

by

TECHNITROL

Technitrol standard or specially-designed delay lines, continuously wound to close tolerances, are extremely compact and very stable. Standard tolerances of these distributed constant delay lines are: on delay, ±5%; on impedance, ±20%. Extremely stable with respect to environmental conditions, they are available cased in epoxy resin or hermetically sealed for military applications.

3½" EPOXY CASE

Standard windings with delays from 0.1 μ sec to 1.0 μ sec and impedances from 560 to 5000 ohms are available in 3½" case and 6" case. This is a stock item.

BD 1000-100

Epoxy resin case with leads grouped at one end. 1 μ sec delay; 1000 ohms impedance; rise time 0.1 μ sec max. This is a stock item.

STEEL CASES
HERMETICALLY SEALED

For multiple stick needs and military applications. Completely sealed, potted in foam. Delays are based on stick capacity and type of winding.

DIP-COATED

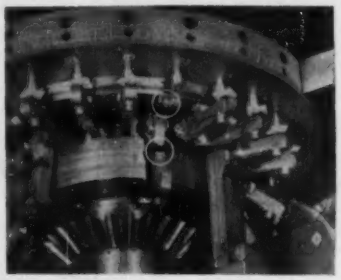
For economy, any standard winding is dip-coated in epoxy resin. Moisture resistant; stable for temperature range from −25°C to +85°C.

Write for New Catalogs

TECHNITROL
ENGINEERING COMPANY
1952 E. Allegheny Ave., Phila. 34, Pa.

the low bin. Rejects are later tested at other values.

An electrical impulse signal causes the plates to drop into the bins. A small U-shaped permanent magnet is mounted midway on the contact arm. Direcly above this magnet is a small electromagnet with mating soft iron poles. With no signal, the magnets remain in contact. When the electromagnet is polarized with a negative signal, it repels the permanent magnet. The contact arm drops out of position and the plate falls into the bin below. Magnet signals are emitted by the bridge.



Contact arms are closed and opened by magnets (circled)

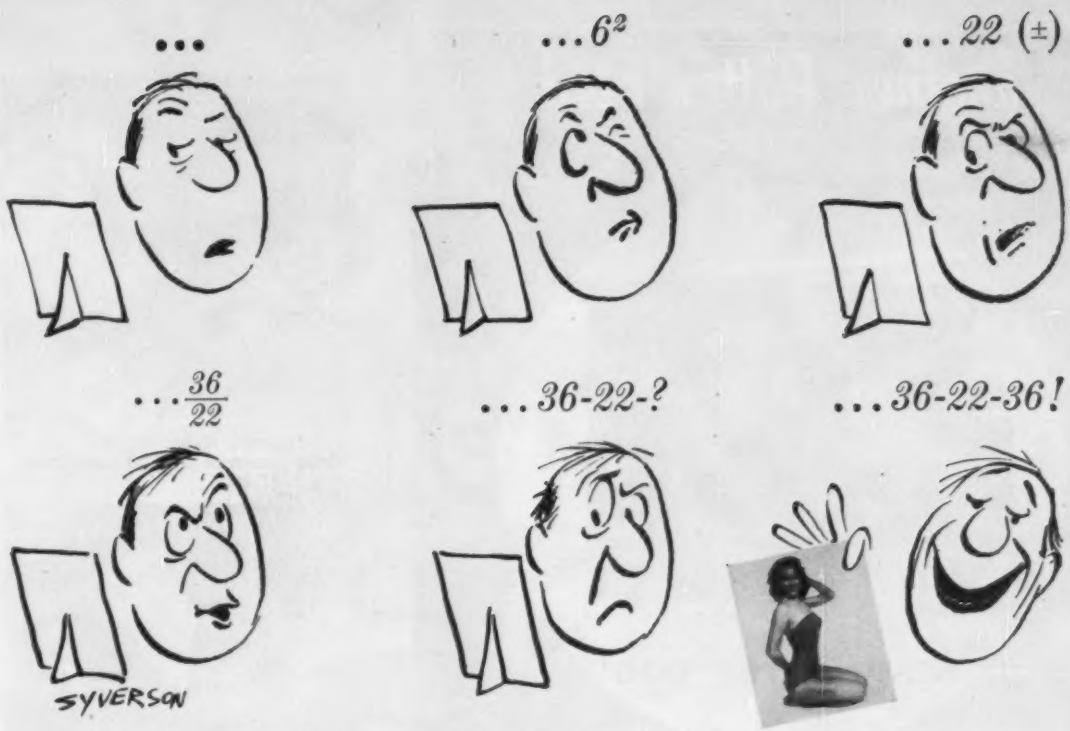
To prevent the electromagnets from depolarizing the permanent magnets, the electromagnets are pulsed with a polarizing current at the moment of contact and closure. This pulse maintains the magnet polarization and also increases the closing magnetic field, insuring contact with the plate being tested.

Resistance Soldering Hollow-Pin Connectors

FAILURE OF SOLDER to completely fill hollow-pin connectors results in high electrical resistance. The joint is also mechanically weak and can be further damaged by handling and shock.

A major electronics firm studied the extent and incidence of voids in pins soldered by conventional conduction soldering irons and Ideal resistance soldering irons. In each case, 60-40 solder was used and the joints inspected by x-ray.

Conduction iron soldering was reported to leave an average of 33 percent voids; resistance soldering



What's the size of your design problem? Facing a multiplicity of project details? It's no laughing matter when you're caught short-handed on a critical design program. You need proved engineering ability **plus** systems capabilities you can count on. Next time... **this** time—

LOOK TO INET FOR UNIQUE DESIGN CAPABILITIES

Here's another example of INET capability: the console, recorders and related instruments built, installed and wired by INET for Atomics International's L-54 nuclear research reactor. The solution-type L-54 reactor, which has a rated power capacity of 5,000 watts, was designed and built by Atomics International for the West Berlin Institute for Nuclear Research. It is being used for German scientific, medical and industrial research.

Engineers desiring a special reprint of the cartoon above should write to "36-22-36," % Inet Division, Leach Corporation.

INET DIVISION LEACH CORPORATION

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THE
NEW POTTER "909"

Now... a device that READS and STOPS faster, better

The compact '909' Perforated Tape Strip Reader now makes it possible to process information from perforated tape into digital data computer systems at high speed and low cost. Simple to operate by clerical personnel, the '909' is completely transistorized, and will give maximum performance with complete reliability.

The '909' is a compact unit, suitable for console or rack mounting. Here are some of the performance features, available for the first time in equipment of this type:

- Character reading speeds up to 1000 char/sec.
- Simple In-Line threading
- 3 Millisec starting time
- Stops on STOP Character, (0.2 millisec) and will read next character after start
- 100 x 10^6 operation pinch roll
- Photo Diode Head reads any tape (including oiled yellow teletype tape)
- Reads 5, 6, 7 or 8 level tape with sprocket channel
- Ambient temperature up to 125° F. with 10,000 hour life
- Built to meet requirements of MIL-E-4158A

Specifications

Tape Speed:
10 to 100 ips

Tape Width:
Any Standard Width

Power Requirements:
115V, 60 Cycle, 1 Phase

Control:
Remote/Level Inputs

Contact your Potter representative or call or write direct for further information.

The mark of Engineering Quality

POTTER INSTRUMENT COMPANY, INC.
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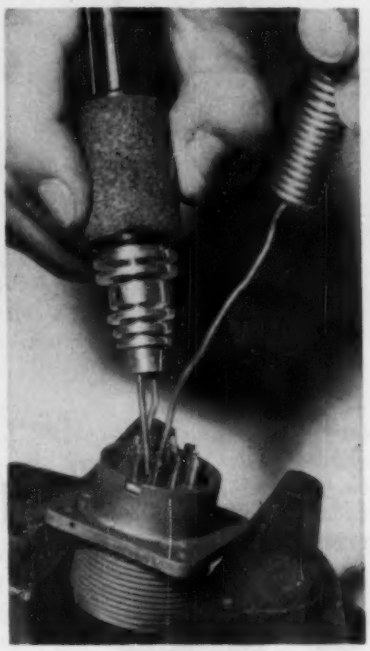
Potter has career opportunities for qualified engineers who like a challenge, and the freedom to meet it.

Two-electrode resistance iron used to solder connector held in bench vise



Iron heats outside of pin while solder ties inside of pin

yielded 14 percent. Void percentages as low as 19 percent for conduction irons and 2 percent for resistance irons were reported in subsequent tests run at approximately normal production rates by operators experienced with the methods used.

An average of 20 percent voids was produced by resistance soldering when an operator experienced in conduction iron soldering, but inexperienced in resistance soldering, was used. In resistance soldering, the work is heated by passing current through the work itself.

Tests were also made of the psychological factors involved when

A MISSILE AND TELEVISION INDUSTRY FIRST. Lockheed-developed, miniaturized TV cameras, designed for both government and commercial use. Only 6 inches long and 2¼ inches in diameter, tiny cameras extend man's vision into the unexplored. Unmanned lunar probes to the far side of the moon; lunar landings; monitoring interiors of manned spacecraft and remote TV coverage of on-the-spot happenings on a scope never before possible are some of the uses foreseen for the cameras.

ELECTRONIC ENGINEERS AND SCIENTISTS

Lockheed Missile Systems Division is systems manager for such major, long-range programs as the Navy Polaris IRBM, Earth Satellite, Army Kingfisher, Air Force X-7 and Q-5 ramjet vehicles, and other important research and development programs.

Responsible positions for high-level, experienced personnel are available in research and development, in our project organizations, and in manufacturing.

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If you hold a degree and are experienced in one of the above fields, we invite your inquiry. Please write to Research and Development Staff, Dept. 2210, 962 W. El Camino Real, Sunnyvale, California.

Lockheed

MISSILE SYSTEMS DIVISION

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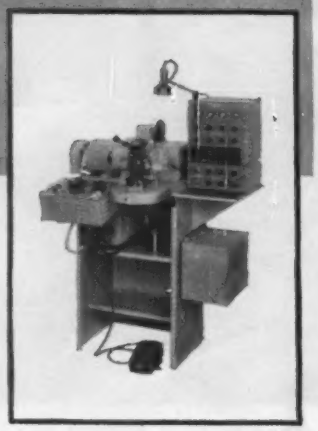
NEW

electronically controlled

TOROIDAL WINDER

TW 300

faster production at lower cost
speeds up to 2000 turns per minute
4-digit, 2- or 7-position predetermined turns counting



The entirely NEW electronic system of the TW 300 provides unmatched features in a toroidal winder . . . proximity pick-up for use with any size wire without physical contact . . . 100% accurate turns counting . . . controlled slow-start, slow-stop driving motor . . . automatic segmental winding with perfect repeatability . . . progressive winding of segments or continuous coils in either direction.

The TW 300, designed for easy servicing and maintenance, cuts production time and operator fatigue to the bone. Flexibility in production of new coil types with superior electrical characteristics is unlimited because of the new control system with automatic winding features. This machine is a significant advance toward complete automation of toroidal winding.

You get the **BEST** *from* **BOESCH**

BOESCH MANUFACTURING COMPANY, INCORPORATED
DANBURY, CONNECTICUT

Use of single-electrode iron. Other lead of transformer is clipped to metal fixture plugged into connector

the operator knew the work would be x-rayed. The results showed that the operator made an obvious attempt to improve performance knowing inspections would be made.

As a result of the test, the firm installed resistance soldering irons in 50 stations soldering Cannon and Winchester plugs.

For the first 2 days, productivity was poor—less than half normal. Quality, however, was as good or better than for experienced conduction iron operators. In 2 to 3 weeks production rates were normal and after 3 weeks, all operators equalled or bettered conduction iron operators and quality had further improved. It was also reported that operators received fewer burns and that this aided employee morale.

Tool Types

Three types of resistance tools were used in the tests, depending on the size of the connection (which determines heat level) and accessibility of the pin to the electrodes. Where the work was very small, a single metal electrode was used and all pins were grounded through a modified receptacle. Small Cannon plugs were soldered

PERFORMANCE PROVEN
...FOR OVER 25 YEARS

H·H RESISTORS and RHEOSTATS

H-H Long-Life Resistors

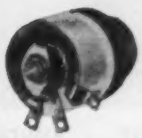
Blue Ribbon Resistors

Rugged blue ribbon resistors provide higher wattage ratings per unit, save space and weight. Construction features high temperature, vitreous enamel, crazeless coating for maximum moisture resistance. Aluminum thru-bar distributes heat uniformly. Corrosion resistant and vibration-proof.

Gray Line Resistors

These dependable resistors feature high temperature gray enamel coating and stronger core for extra dependability under the most extreme operating conditions. All wire connections on H-H Long Life Resistors feature all welded construction. The fixed, ferrule and adjustable types meet MIL-R-26 specifications.

TYPE A RHEOSTATS (25 Watts)



Functions smoothly under the most adverse conditions. Terminals of strong, corrosion resistant alloy, are permanently welded to winding form. Wound ring is made an integral part of the refractory base by vitreous enamel. Shafts are insulated. Three terminals permit use as potentiometer or rheostat.

TYPE AM RHEOSTATS (25 Watts)

Featuring porcelain-vitreous enamel construction, Type AM rheostats are exceptionally rugged, compact and possess excellent heat dissipating characteristics. Resistive element is wound on a flat, pure mica form, placed within a refractory base and completely embedded in vitreous enamel.

TYPE AMS RHEOSTATS (25 Watts)

This type Hardwick Hindle Rheostat includes all the electrical and mechanical advantages featured in the Type AM with lug terminals. However, Type AMS Rheostats incorporate screw type terminals.

TYPE H RHEOSTATS (50 to 1000 W.)

High temperature enamel affords maximum safety under overloading. H-H bus-bar construction provides ample resistance, ample safety under maximum current requirements. Constant pressure contact arm provides trouble-free operation.

Hardwick Hindle quality components offer circuit designers and engineers exclusive electrical and mechanical features. These design "plus" factors provide complete dependability where severe operating environments are encountered in commercial or military service. Complete data on H-H Rheostats and Resistors is available on request. Call or write for illustrated resistor and rheostat catalogs today!
Standard stock items available for immediate delivery from authorized local electronic parts distributors.

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High Voltage,

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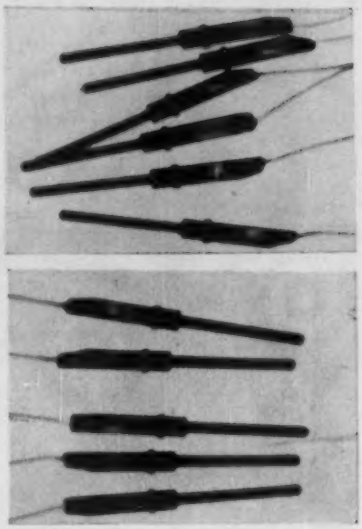
CAPACITANCE

. . . in small space

. . . and *trouble-free*

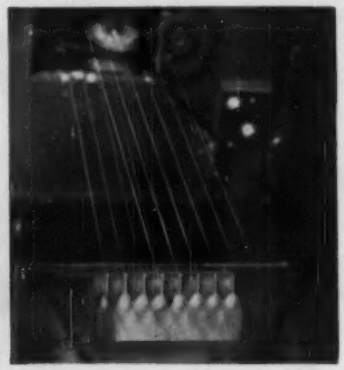
For lump capacitance at high voltage and/or high current, Lapp Gas-Filled Condensers offer the advantages of extreme compactness . . . low loss . . . high safety factor . . . elimination of puncture hazard . . . construction with gaskets which can be externally tightened under full operating pressure . . . assurance of *long trouble-free service.* Variable and fixed units are available with capacitances to 30,000mmf; current ratings to 400 amps at 1 mc; operating voltages to 80 Kv peak. Write for Bulletin 302 with complete description and characteristics data. Lapp Insulator Co., Inc., Radio Specialties Division, 147 Sumner St., Le Roy, N. Y.



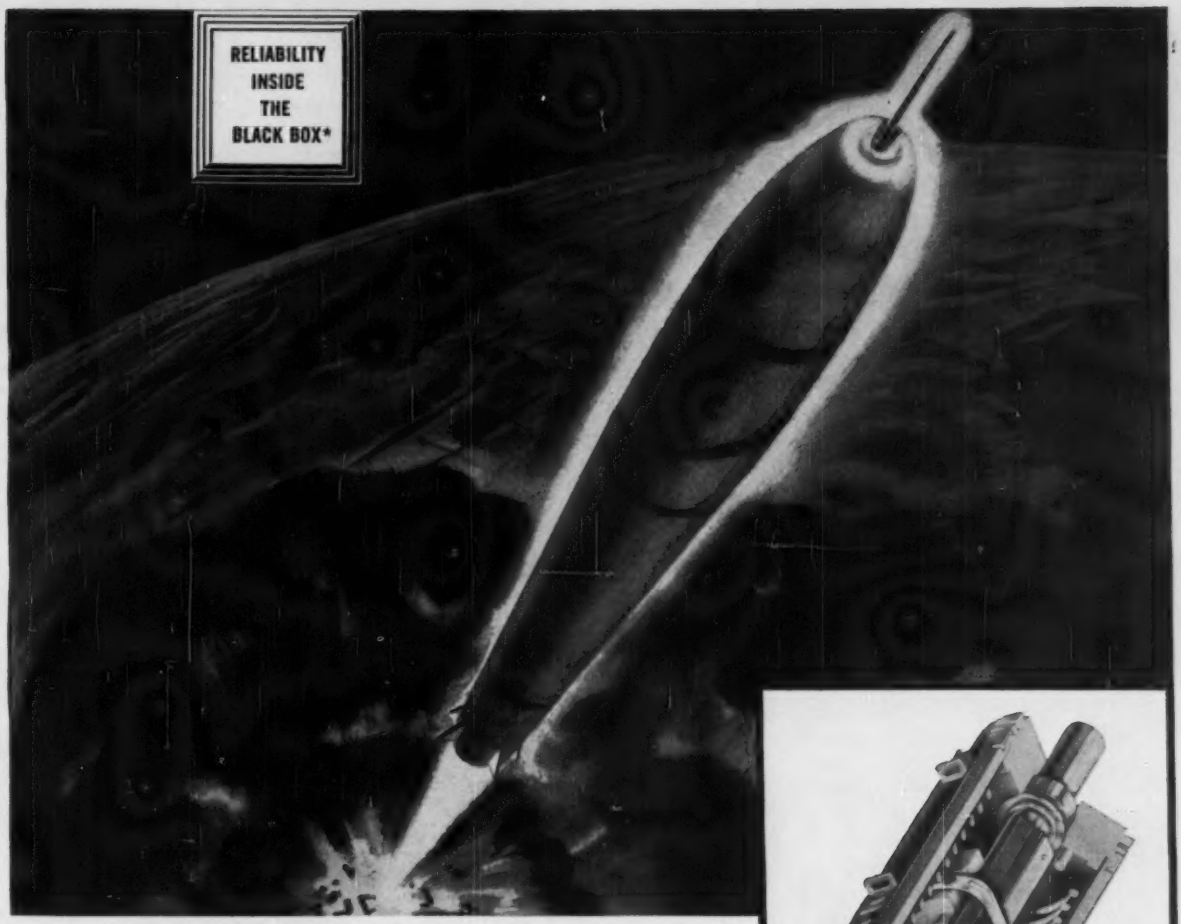
X-rays of (top to bottom) pins soldered by conduction iron and resistance iron

with 2 metal electrodes in a single, pencil-type handle. Larger plugs were soldered with a single carbon electrode and the modified grounding receptacle. Conduction soldering irons were single-outlet types with ¼-inch tips.

Coating Heater Wire



CONCENTRICITY of insulation coatings on tungsten tube heater wires is improved by method developed by General Electric Receiving Tube Dept., Owensboro, Ky. Wire is passed through a slotted hole in the lip of a small cup and positioned so that it does not touch the cup. Coating material is pumped into the cup at constant level and consistency. The coated wire passes directly into an oven. Coating thickness is increased by repeating passes through the slurry and oven.



The Pot Thor's thunder couldn't shake!

Only Fairchild's "Pot" Could Meet the Specs for a Big 15G Jolt ... Then Took 12G's More as a Safety Factor*

When the prime contractor on the first guidance system for the Air Force Thor missile required a potentiometer that could take punishment Fairchild was called in. Fairchild's sales engineer working with one of Fairchild's Customer Engineering Groups and the contractor's Standards Engineers, developed the rugged 1" diameter precision 10-turn potentiometer on your right.

This "pot" features a **unique mechanical wiper tab drive** perfected by Fairchild which is **separate** from the helical coil of resistance wire. This minimizes winding wear and electrical backlash thereby extending life and accuracy. Fairchild's design also offers tight linearity tolerance, high temperature performance, low noise levels and is available in resistance ranges between 1K ohms and 2 megohms, and in diameters of ½", 1" and 1-13/16".

The Fairchild potentiometer line is complete. It is the result of careful research and design, of rigid incoming materials inspection, of sub-assembly and final inspection plus performance testing and environmental testing to destruction of random samples.

Write or call for the new condensed catalog – Fairchild Controls Corporation, Components Division, Dept. 12E.

***Fairchild's Built-in SAFETY FACTORS Beyond the Specs for Reliability in Performance.**

THE PROBLEM: A small, multi-turn potentiometer was required for the "black box" in the Thor missile which had to withstand severe environmental conditions, and have characteristics of low noise with no discontinuity under vibration, shock and acceleration.

THE SOLUTION: A special high-reliability design of the Fairchild standard type 920, 10-turn potentiometer, a design demanding the closest tolerances, selected materials, and special assembly techniques. The result — a "pot" which delivered a safety factor beyond the specs that helps to assure reliability.

Environmental Tests	Contractors Specification	Fairchild Performance
Vibrations	2-2000 cps—15G	2-2000 cps—30G
Shock	100G	125G
Acceleration	Constant 17G	Constant 50G

In addition, the units were vibrated at resonant peaks between 2-2000 cps from 25G to 50G for 15 minutes without electrical or mechanical degradation.

Potentiometers
Rate Gyros
Pressure Transducers
Accelerometers

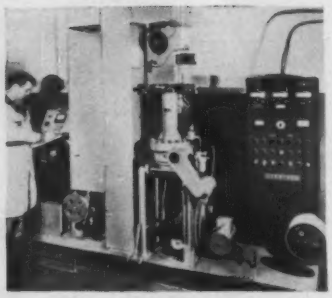
RELIABILITY INSIDE THE BLACK BOX*

FAIRCHILD CONTROLS CORPORATION

COMPONENTS DIVISION

225 Park Avenue, Hicksville, L. I., N. Y. — 6111 E. Washington Blvd., Los Angeles, Cal.

New '59 Products

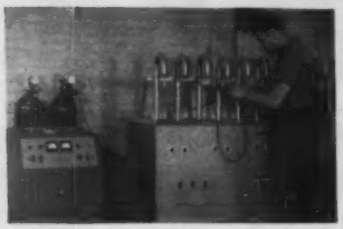


Extruding Machine triples wire output

JENNINGS MACHINE CORP., 3452-A Ludlow St., Philadelphia 4, Pa. The TE-1A Teflon extruding machine handles wire in a unique way through triple-pass vaporizing and sintering ovens to increase extrusion speed three-fold without adding to oven length. Optional oven set-ups also allow single-pass handling for best quality and efficiency. Should the wire break, restringing is a minor job because saddles on each sheave prevent the wire from dropping. **Circle 300 on Reader Service Card.**

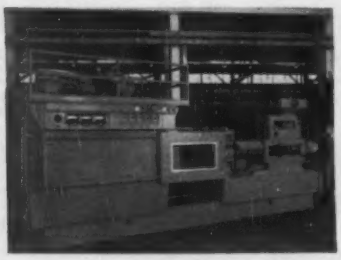
Centrifuge small, compact

GENISCO, INC., 2233 Federal Ave., Los Angeles 64, Calif., has developed an inexpensive centrifuge for production-line acceleration testing and evaluating of missile and aircraft components. G-range of the machine is from 1 to 800 g's with an aggregate payload capacity of 1,000 g-pounds. Rotational rates are infinitely variable and are monitored by a tachometer which permits speed selection within ±1 percent accuracy. **Circle 301 on Reader Service Card.**



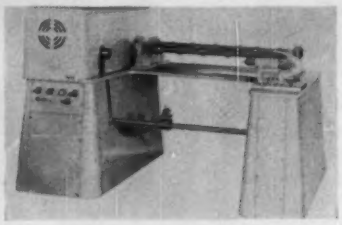
Leak Detector highly sensitive

CONSOLIDATED ELECTRODYNAMICS CORP., 300 N. Sierra Madre Villa, Pasadena, Calif. Type 24-110A leak detector is a special type of mass spectrometer "focused" on mass 4 (helium). It locates and gives a precise indication of the size of leaks in pressure, vacuum, and hermetically sealed equipment. Leak detection is a quality-control method that assures top-notch performance in products, cutting customer complaints and prolonging life of many components. **Circle 302 on Reader Service Card.**



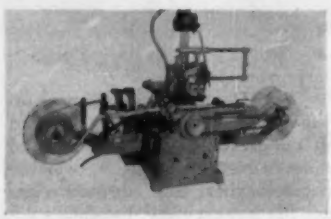
Molding Machine for plastics

NATIONAL AUTOMATIC TOOL CO., INC., Richmond, Ind. The Natco 300 plastics injection molding machine is designed to mold all commonly used thermoplastic materials. It will single-plunger feed 22 oz of general purpose polystyrene. Its capacity in low density polyethylene is 12 oz-single feed, 21 oz-double feed. It can attain maximum clamping pressure of 325 tons in less than a half-second. Rated plasticizing capacity in general purpose polystyrene is 130 lb per hr. It has interchangeable injection plungers and feed bushings for either 20,000 or 30,000 psi. **Circle 303 on Reader Service Card.**



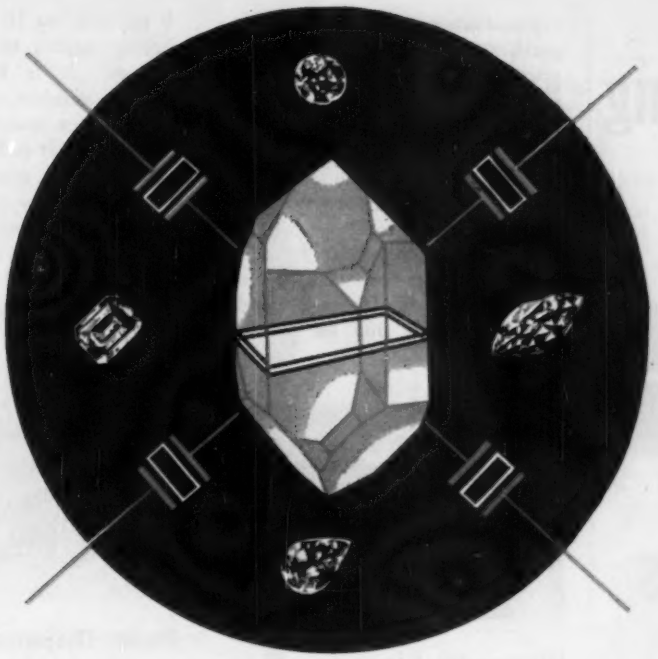
Core Winder semiautomatic

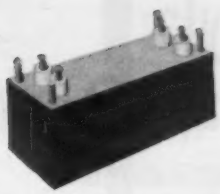
GEO. STEVENS MFG. CO., INC., Pulaski Road at Peterson, Chicago 46, Ill., has developed a new semiautomatic machine which winds transformer cores in completely variable lengths to a maxium of 10 in. in multiples of 3. Maximum core o.d. is 25 in., maximum distance for multiple winding 40 in. and output end of spindle 2¾ in. keyed slot. Emergency stop button halts winding instantly at any point of winding cycle. Jogging switch permits additional core diameter build-up after winding cycle has ended and also permits arbor to be placed in desired position before winding begins. **Circle 304 on Reader Service Card.**



Marking Machine high speed unit

MARKEM MACHINE CO., Keene 64, N. H. Die-cut pressure sensitive paper, gummed paper and other





HOW TO SIMPLIFY CIRCUIT DESIGN WITH BURNELL CRYSTAL FILTERS

Through advanced crystal filter production techniques and circuitry by Burnell & Co., it is now possible to overcome numerous design problems formerly believed insoluble with even the best individual toroidal components.

FREQUENCY RANGE EXTENDED

Depending on band width and frequency, filters may be composed entirely of crystals or in complex networks, combine quartz crystal elements with stabilized toroidal coils to produce the desired band width and shape factor. Frequency has been extended from low range up to 20 megacycles.

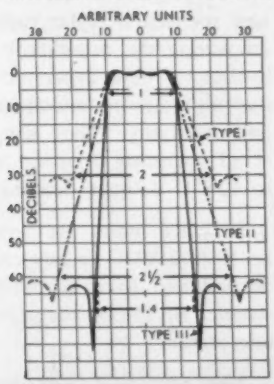
TRANSISTOR TO PENTODE OPERATION

Economy is achieved with standardized complex designs of lattice networks and their three terminal network derivatives. Packaging encompasses a wide range in standard, miniature and sub-miniature sizes with considerable latitude in permissive impedance range from transistor usage to pentode operation.

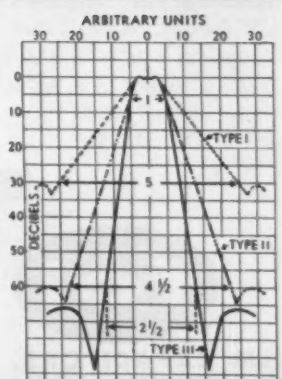
STANDARD DESIGN OR CUSTOM ENGINEERED

Whether you need crystal filters of standard design or custom units engineered to specifications of center frequency, band width, selectivity and impedance level, the facilities of Burnell & Co. are at your disposal. Write for new Burnell Crystal Filter Bulletin XT-455.

TYPICAL RESPONSE CURVES INDICATING THE VARIOUS SHAPE FACTORS AVAILABLE IN STANDARDIZED BURNELL CRYSTAL FILTERS



WIDE BAND CRYSTAL FILTER



NARROW BAND CRYSTAL FILTER

Burnell & Co., Inc.

PIONEERS IN TOROIDS, FILTERS AND RELATED NETWORKS

EASTERN DIVISION
10 PELHAM PARKWAY
PELHAM, N. Y.
PELHAM 8-5000
TWX PELHAM 3633

PACIFIC DIVISION
720 MISSION STREET
SOUTH PASADENA, CALIFORNIA
RYAN 1-2841
TWX PASACAL 7578

fci
self-healing
metallized
miniature
mylar
capacitors
...the ultimate in precision self-healing capacitors...

FCI presents a wide range of new metallized mylar capacitors employing the principle of self-healing. These capacitors offer the ultimate in miniaturization and reliability. They can withstand operating temperatures up to 125°C without derating.

Standard units are available up to 600 VDC in any capacity desired and have insulation resistance of 25,000 megohms per microfarad.

The new FCI Self Healing Metallized Mylar Capacitors are furnished in bathtub cases, CP70 cases, or metal shell cases. A typical size is a 4MFD/400 VDC capacitor in a hermetically sealed metal shell 1⅛" O. D. by 2¼" L.

fci
FILM CAPACITORS, INC.
3404 PARK AVENUE • NEW YORK 56, N.Y.
A full line of industry standard metallized paper capacitors are also available
CIRCLE 88 READERS SERVICE CARD

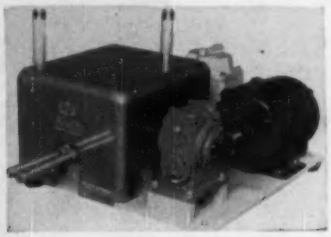
types of labels in roll form that are partially preprinted may be overprinted with extremely accurate registration, or marked completely from blank stock, with a Markem model 126AF machine. The stock is fed from a roll, printed or imprinted and then either re-rolled, perforated and re-rolled, or cut and stacked. Operating speeds from 70 to 100 labels per minute may be attained depending on label material size. **Circle 305 on Reader Service Card.**

Ultrasonic Cleaner
industrial size

THE NARDA ULTRASONICS CORP., 625 Main St., Westbury, L. I., N. Y. The 1500 series ultrasonic cleaning equipment comprise the 200 w output SonBlaster ultrasonic generator and its companion 5-gallon transducerized tank which measures 14 in. by 10 in. by 9¼ in. deep. More than 35 soils common to metal, glass, plastic, ceramic, stone, rubber, leather, textile and paper products, parts and assemblies can be removed in seconds by the series 1500. Prices for the complete systems begin at $645. **Circle 306 on Reader Service Card.**

Processing Tank
ultrasonic type

THE GENERAL ULTRASONICS CO., 67 Mulberry St., Hartford 3, Conn., has introduced a new ultrasonic processing tank with a capacity of 5 gallons. The stainless steel treatment chamber is 14 in. long by 9 in. wide by 10 in. deep and is heliarc welded to aircraft specifications. It is fitted with two welded stainless steel drain connections for recirculation of process liquids. It is fully powered by the GU-420 generator with an output of 400 w continuous at 20 kc. Power connections to the tank are by a heavy duty waterproof connector. **Circle 307 on Reader Service Card.**



Resin Dispenser
time-saving device

DELSEN CORP., 719 W. Broadway, Glendale 4, Calif., has available a positive displacement, resin dispenser for use with liquid resin and hardener systems. Accurately calibrated to meter both liquid hardeners and resin in exact proportions, it has been serving a useful purpose in plastic fabricating plants, eliminating the necessity for time-consuming weighing operations. The resin material is accurately metered through drip-proof valves. Both hand driven and motor driven models are available. **Circle 308 on Reader Service Card.**

Diode Tester
automatic unit

ATLANTIS ENGINEERING CORP., 1807 Stratford Drive, Garland, Texas. The T-501 automatic diode tester is designed for production

Is one of these FOUR DUPLEXER TECHNIQUES right for you...

To secure optimum performance and reliability in your duplexer system you now have a choice of five basic techniques.

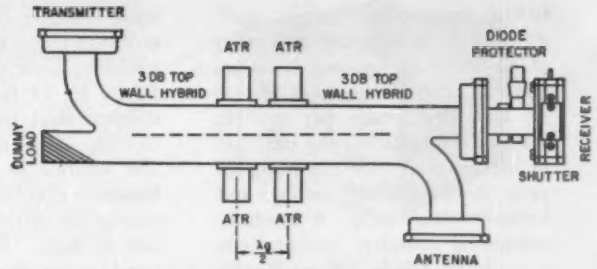
Microwave Associates is in a position to give you completely unbiased recommendations because we design and manufacture all types of gas tube and ferrite devices for duplexer applications.

If you have a current problem in this field our application engineering service is at your disposal.

...OR do you need OUR NEW FERRITE DUPLEXER?

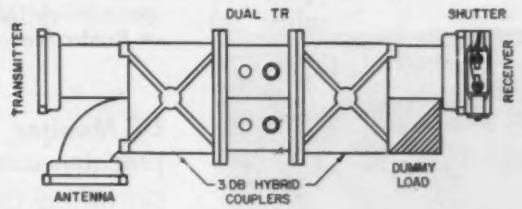
Write or call...

1



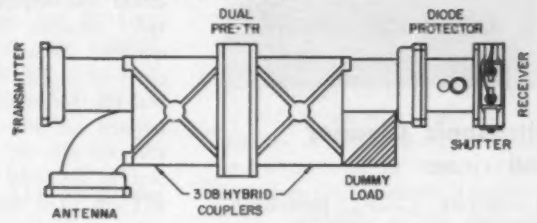
BALANCED DUPLEXER: 4 ATR's, DIODE PROTECTOR, SHUTTER

2



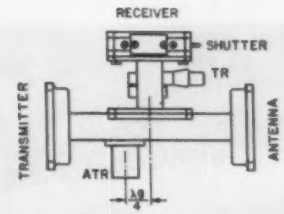
BALANCED DUPLEXER: DUAL TR, SHUTTER

3



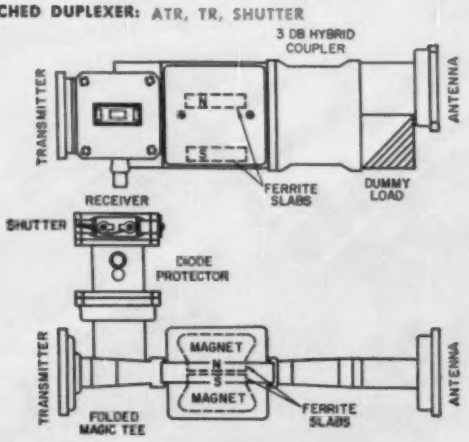
BALANCED DUPLEXER: DUAL PRE-TR, DIODE PROTECTOR, SHUTTER

4



BRANCHED DUPLEXER: ATR, TR, SHUTTER

5

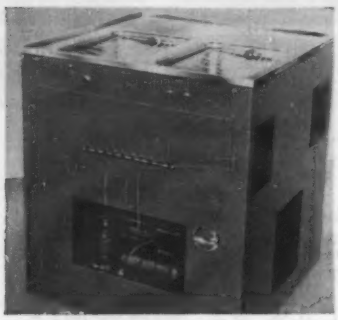


FERRITE DUPLEXER: DIODE PROTECTOR, SHUTTER

MICROWAVE ASSOCIATES, INC.

BURLINGTON, MASSACHUSETTS TELEPHONE BROWNING 2-3000

testing, engineering analysis, quality control, or incoming inspection of in-line lead, packaged diodes and rectifiers. It has a test rate of up to 3,600 diodes per hr. It features automatic sorting into one of eleven categories according to peak inverse voltage ratings and forward voltage drop. A brochure containing complete specifications is available. **Circle 309 on Reader Service Card.**

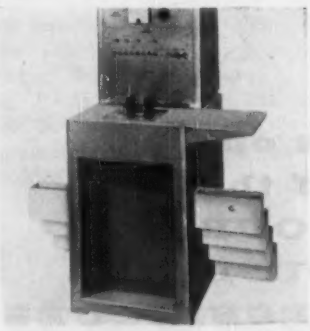


Ultrasonic Cleaner and rinser

BLACKSTONE CORP., Jamestown, N. Y., has introduced a new ultrasonic cleaning equipment for the precision cleaning of parts and assemblies. Unit illustrated has two 10 in. by 14 in. by 10 in. deep stainless steel tanks for ultrasonic cleaning and ultrasonic rinsing. The solution in each tank is continuously circulated and filtered to remove all particles of 2-5 micron size or larger. Each tank is activated by multi-element magnetostrictive transducers operating at approximately 20 kc. **Circle 310 on Reader Service Card.**

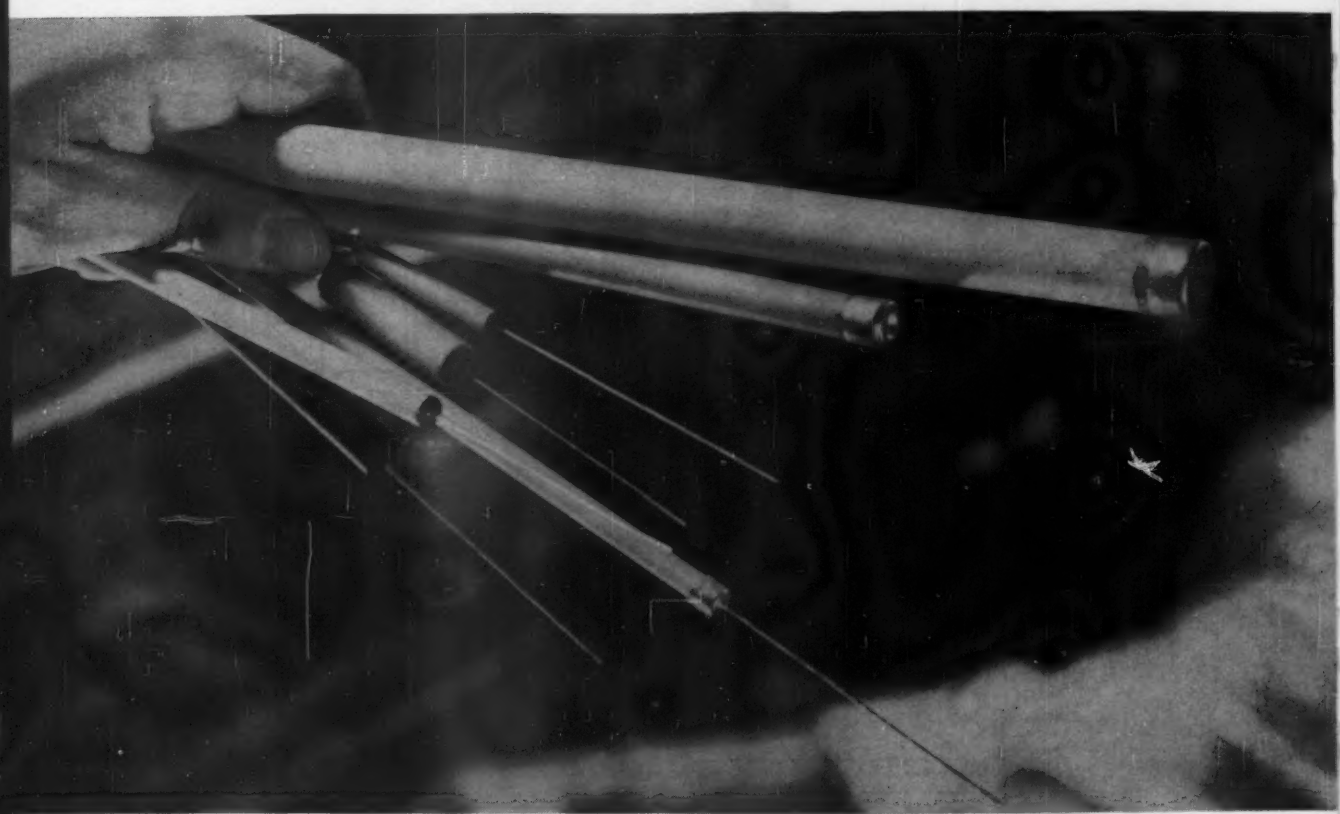
L-F Monitor precision unit

ERIE RESISTOR CORP., 644 W. 12th St., Erie, Pa. The 660 series precision low-frequency monitor provides constant indication of frequencies between 50 and 1,600 cps with 5-place resolution. Model 660-400, for example, is specifically tailored for 400 cycle monitoring and provides an accuracy of 0.01 percent over the range of 396 to 404 cps. The 660 series uses the NIXIE indicator for readout. A transfer storage unit provides a continuous digital presentation. **Circle 311 on Reader Service Card.**

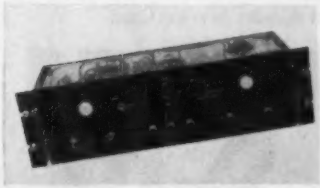


Capacitor Grader semiautomatic

EDER ENGINEERING CO., INC., 1568 S. First St., Milwaukee 4, Wisc. Model 2984 is especially designed to test, grade and sort a wide range of capacitor values in a fast production operation. Basic features include: hand-loading into a preset jig at rates up to 30 per minute; automatic processing and delivery into an integrated chute



system with removable bins at each side of the machine; and a complete bridge system with appropriate grading channels. **Circle 312 on Reader Service Card.**

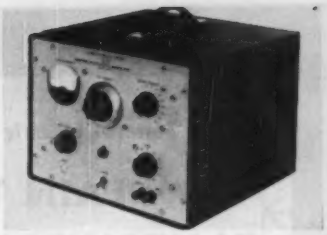


Sequence Tester automatic unit

Optimized Devices, Inc., P. O. Box 38, Gedney Station, White Plains, N. Y. The Auto-Test programs and performs any number of pre-operational go, no-go tests and then initiates the operation only upon successful completion of the test sequence. Any no-go indication halts the test sequence at the offending channel. A number of built-in features, such as complete self-test before each test sequence, make the unit virtually foolproof. Advantages lie not only in time saved but especially in the automatic operation which prevents human operator errors. The tester is readily adapted to all forms of measurement. Suitable transducers permit checking of physical as well as electrical quantities. **Circle 313 on Reader Service Card.**

Counter-Controller dual preset

Computer Measurements Corp., 5528 Vineland Ave., North Hollywood, Calif., has available a line of dual preset counter-controllers. Series 320 instruments are designed for coil winding, motor speed control, shearing to length, batching, packaging, and stacking by number, variable pulse interval generation, and process programming. Used in conjunction with a CMC frequency-period meter, these instruments can be used for very accurate low-frequency measurements. **Circle 314 on Reader Service Card.**



Stability Tester for stalos

Airborne Instruments Laboratory, 160 Old Country Road, Mineola, N. Y. Type 392-B frequency stability tester permits the measurement of oscillator frequency stability in the approximate bands of 1,120 to 1,700 mc and 2,600 to 3,200 mc. It is designed primarily for measurement of frequency stability over the short-term intervals, (less than 1 sec) likely to be of interest in radar. Thus it is particularly useful to measure the stability of stable local oscillators (stalos) as used in moving target indicators (MTI radars). The sensitivity normally allows measure-

Westinghouse high-voltage cartridge rectifiers from 4—400 cells, now available in wide variety of tube materials and terminals

For virtually every high voltage rectifier application . . . there's an inexpensive Westinghouse selenium rectifier cartridge to meet your needs. Available in phenolic, glass epoxy and glass . . . cartridge ends of brass, studs and axial leads . . . from 100 to 100,000 volts . . . 1 to 100 milliamps.

Made by superior vacuum evaporation deposit process, Westinghouse cartridge rectifiers offer the lowest leakages in the industry. In addition, dependable Westinghouse selenium rectifiers shrug off momentary short circuits and overloads . . . combine greater reliability with longer operating life.

Look to Westinghouse for all your rectifier needs. All standard models available for immediate shipment . . . custom-made types designed, manufactured and shipped to you within 7 days. Contact your nearby Westinghouse representative for details, or write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pa.

J-22131

POWER-UP starts with CONTROL

YOU CAN BE SURE...IF IT'S Westinghouse

From General Electric . . .

PLAIN TALK ON TANTALYTIC* CAPACITOR AVAILABILITY

It's time for plain talk on the facts of tantalum electrolytic capacitor availability. There is no "availability" problem as far as General Electric is concerned.

Here's why:

- No metal shortage—Stocks of capacitor-grade tantalum have doubled within the past year.
- No production capability shortage—General Electric's production facilities have tripled in the past year.
- No delivery bottlenecks—General Electric's improved manufacturing processes and techniques have virtually eliminated production rescheduling.
- Few military directive priorities—Since the supply of Tantalytic capacitors has met demand, the military requirements can be met without directive priorities.

This is why we say—now and in the future, General Electric will continue to provide Tantalytic capacitors in the types and ratings you want—when you want them.

For specific information on Tantalytic capacitor ratings, prices, deliveries, contact your nearest General Electric Apparatus Sales Office or write to General Electric Co., Section 449-4, Schenectady 5, N. Y.

*Registered trade-mark of General Electric Co.

**Trade-mark of General Electric Co.

SOLID TANTALYTIC CAPACITORS—for transistorized circuit applications—rated up to 60 volts, polar units only—sizes down to 0.125 inches by 0.250 inches.

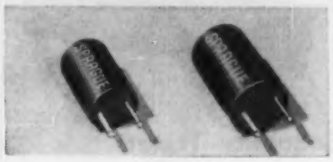
KSR** TANTALYTIC CAPACITORS—for missiles, radar, airborne electronic equipment applications—ratings up to 3500 mfd—three case sizes 1.375, 2, 2.5 inches in height.

125C TANTALYTIC CAPACITORS—for aircraft electronic systems—ratings 10-180 mfd, 30 to 100 volts. Sizes ½ to 1⅛ inches in height. Also tubular, double-cased units.

85C TANTALYTIC CAPACITORS—for applications requiring high quality but where temperatures are less severe.

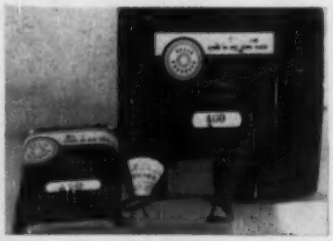
GENERAL ELECTRIC

ment of short-term frequency stability to at least 1 part in 10^9. The unit can also be used for measuring long-term frequency drift, but in this application its accuracy is reduced to 1 part in 10^8. **Circle 315 on Reader Service Card.**



Electrolytics transistor-type

SPRAGUE ELECTRIC CO., 35 Marshall St., North Adams, Mass. Known as type 31D Cera-lytic capacitors, the new tiny tubular electrolytics are of a special low leakage current construction to meet the requirements of transistor circuitry. High-purity aluminum foil capacitor sections are housed in a dense steatite tube with plastic resin end fill for protection against mechanical damage and atmospheric humidity. This construction is said to result in capacitors with excellent performance for the intended applications, at quite reasonable cost. **Circle 316 on Reader Service Card.**



Potting Compound high-heat

CARL H. BIGGS CO., 2255 Barry Ave., Los Angeles 63, Calif., announces Helix potting compound P-460, a 100 percent epoxy resin compound offering extreme hardness and a wide temperature range from −80 F to +450 F. It is poured cold, cures in about two hours at room temperature, and offers less than 1 percent cure shrinkage. P-460 has good dielec-

AER -O- COM

DEFINITELY DEPENDABLE!

Aerocom's Dual Automatic Radio Beacon

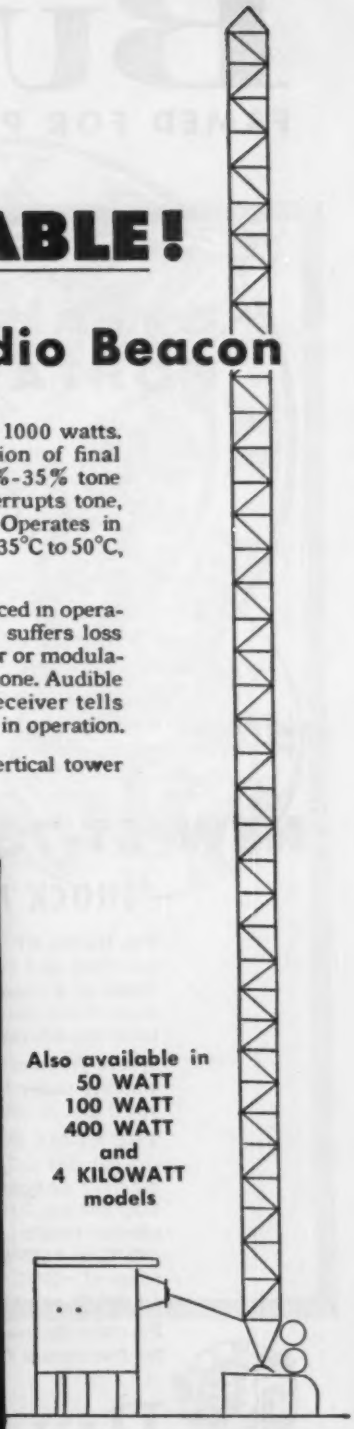
Reliability is built into every part of this dual 1000-watt aerophare unit. Ruggedly constructed and conservatively rated, it provides trouble-free unattended service, and at truly low operating and maintenance cost. It operates in the frequency range 200-415 kcs, using plug-in crystal for desired frequency.

Uses single phase power supply, nominal 220 volts, 50 or 60 cycles. Consists of two 1 kw transmitters with keyer (2 keyers if desired), automatic transfer unit and weatherproof antenna tuner. Each transmitter housed in separate standard rack cabinet, with controls in rack cabinet between the transmitters.

Nominal carrier power is 1000 watts. High level plate modulation of final amplifier is used, giving 30%-35% tone modulation. P-T switch interrupts tone, permitting voice operation. Operates in ambient temperatures from -35°C to 50°C, humidity up to 95%.

Standby transmitter is placed in operation when main transmitter suffers loss (or low level) of carrier power or modulation, or continuous (30 sec.) tone. Audible indication in monitoring receiver tells when standby transmitter is in operation.

Antenna may be either vertical tower or symmetrical T type.



Also available in
50 WATT
100 WATT
400 WATT
and
4 KILOWATT
models

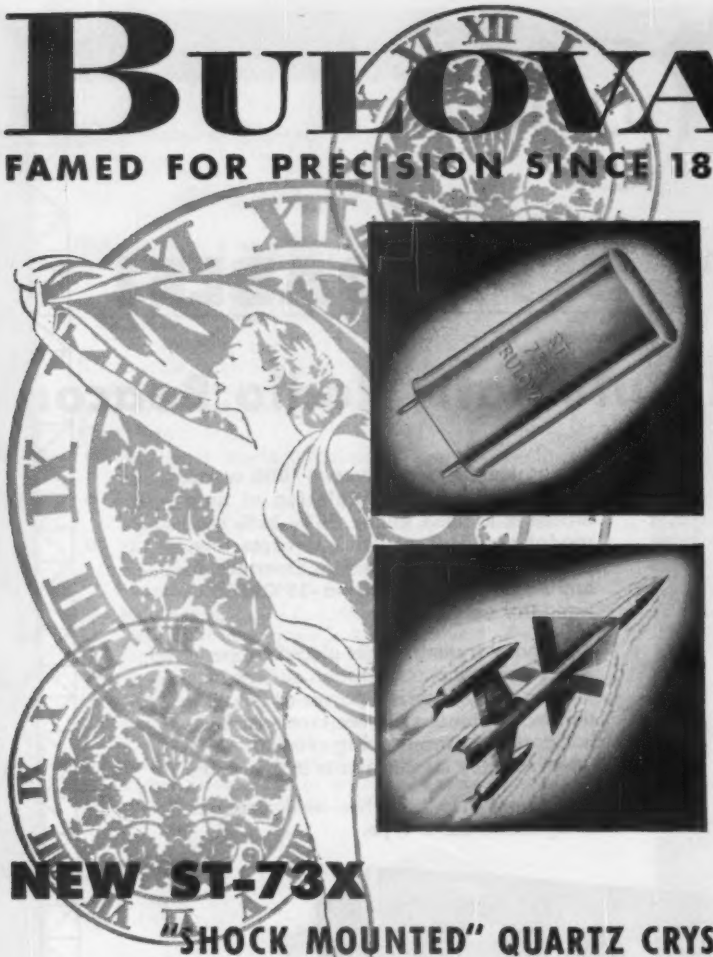
A-101

AER -O- COM

3090 S.W. 37th AVENUE • MIAMI, FLORIDA

BULOVA

FAMED FOR PRECISION SINCE 1875



NEW ST-73X

"SHOCK MOUNTED" QUARTZ CRYSTAL

The Bulova ST-73X need never be babied. Effective new shock mounting and traditional Bulova manufacturing precision result in a rugged, extremely stable, frequency determining element for missiles, aircraft and other applications involving extreme environmental problems.

Where frequencies must be maintained with ultra-reliable stability under high shock and temperature conditions, you'll find no adequate substitute for Bulova quality.

THE ST-73X FEATURES: Frequency Range from 16 KC through 350 KC, with lower frequencies possible in holders of different configuration; Shock Tests of 100 G; Dynamic vibration tests met per MIL-T-5422, MIL-E-5272 and MIL-E-5400 without adverse results; Storage Temperatures over a range of −65°C. to +135°C. can be coupled with an operation temperature range of −55°C. to +100°C.; Low excursions of frequency (±.015%) over this range.

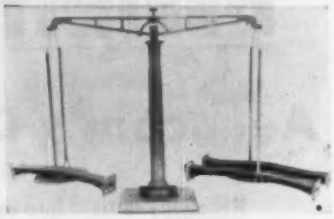
Precision Bulova Quartz Crystals are now available in quantity for frequencies from 16 KC and lower to 100 MC and above.

BULOVA
watch company

Electronics Division
Woodside 77, N.Y.

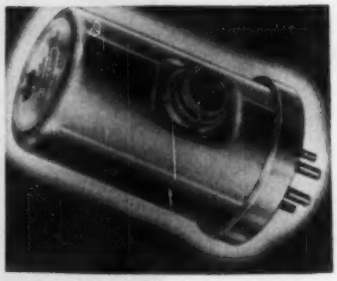
Write Dept. A-738 For Full Information and Prices on Quartz Crystals

tric strength and a very low water absorption factor, making it ideal for encapsulating electrical components vulnerable to moisture and fungus. **Circle 317 on Reader Service Card.**



Flexible Waveguides light weight

AIRTRON, INC., 1096 W. Elizabeth Ave., Linden, N. J., has achieved a 2-to-1 weight reduction in flexible waveguide assemblies through the use of aluminum tubing and aluminum flanges in combination with a new featherweight jacket. The all-aluminum construction of Flexaguides allows special brazing techniques to minimize corrosive action. They can also be manufactured in complex bend configurations without expensive tooling. **Circle 318 on Reader Service Card.**



D-C Chopper low-noise

MILLIVAC INSTRUMENTS, P.O. Box 997, Schenectady, N. Y. Type DCM-99K-1 d-c modulator is a spdt chopper which has less than 5μv d-c offset and drifts less than 2 μv over a long period of time. Normal contact dwell time is 55 percent and will be maintained within better than 2 percent during the first 1,000 hours of operation. Further dwell time changes, after

ELECTRONICS IN BRITAIN

PEAK CURRENTS UP TO 2 AMPS WITH THIS SMALL THYRATRON

EN32 (6574)

This new inert gas filled thyratron by Mullard is ideally suited for use in compact electronic control equipment. In addition to its small size and high current capacity, it has the advantage of quick heating time, high permissible grid resistance, negative control characteristics, and the ability to operate over a wide ambient temperature range. The combination of a Xenon gas filling and the modern Bantal construction contribute to long life of the tube, and permit it to be mounted in any position.

Brief technical details of the EN32 are given here; for further information write to one of the distributors listed below.

TECHNICAL DATA		
Maximum average cathode current	0.3	(A)
Maximum peak cathode current	2.0	(A)
Maximum peak inverse anode voltage	1300	(V)
Maximum peak forward anode voltage	650	(V)
Cathode type	Indirectly heated	
Heater voltage	6.3	(V)
Heater current	0.95	(A)
Minimum valve heating time prior to conduction	15	(sec)
Maximum seated height	2¾ inches	
Base	Octal	

Supplies available from:

In the U.S.A.

International Electronics Corporation
Dept. E-10, 81 Spring Street, N.Y.12,
New York, U.S.A.

In Canada

Rogers Electronic Tubes & Components
Dept. IJ, 116 Vanderhoof Avenue,
Toronto 17, Ontario, Canada.

Mullard

ELECTRONIC TUBES used throughout the world

"Mullard" is the Trade Mark of Mullard Ltd., and is registered in most of the principal countries of the world.

MULLARD OVERSEAS LTD., MULLARD HOUSE, TORRINGTON PLACE, LONDON, ENGLAND
MEV 71

Dynamic Analysis of Frequency Response

A combined sweep generator and c.r.o. suitable for v.h.f., i.f., and v.f. response analysis

FEATURES

• Sweep width variable up to 10 Mc • Crystal controlled fixed-frequency marker pips • Calibrated continuously variable frequency marker • High output • Sensitive Y amplifier • Output level controlled by piston attenuator

APPLICATIONS:
Alignment and response measurement on television and f.m. v.h.f. receivers; v.s.w.r. of feeder lines; matching feeders to antennas; direct tests on i.f. and r.f. transformers; use as a general purpose oscilloscope.

ABRIDGED SPECIFICATION
Frequency Range: R.F. 50-75 Mc, 75-115 Mc, 150-216 Mc; I.F. 10-45 Mc; V.F. 5 kc-10 Mc.
Output Range: 100 μV-100 mV.
Sweep Width: variable from 500 kc to 10 Mc.
Calibration: continuously variable marker oscillator provides pip corresponding to known frequency, 3-frequency crystal oscillator generates pips at intervals of 5.0, 1.0 and 0.5 Mc.
Time Base: 12 to 50 cps for sweep, 12 cps to 10 kc for general purpose.
TUBES: 5Z4G, 12AT7, 12AU7, 12AX7, 6C4, 6AK5, 6AK6.

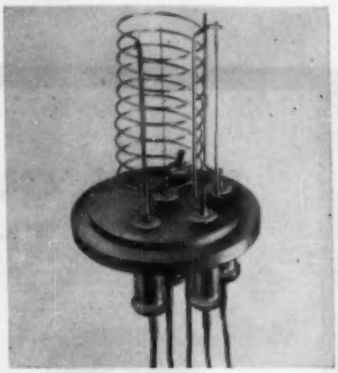
MARCONI INSTRUMENTS

**111 Cedar Lane
Englewood
New Jersey**

CANADA: CANADIAN MARCONI CO · 6035 COTE DE LIESSE · MONTREAL 9
ENGLAND: MARCONI INSTRUMENTS LIMITED · ST. ALBANS · HERTFORDSHIRE

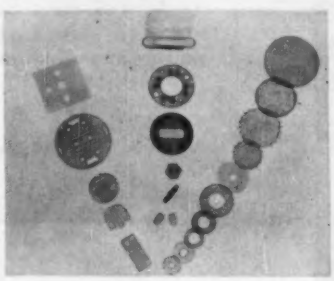
TC 125

1,000 hr, are negligible. The life expectancy is 10,000 to 25,000 hr. **Circle 319 on Reader Service Card.**



Ionization Gage choice of filaments

VEECO VACUUM CORP., 86-P Denton Ave., New Hyde Park, L. I., N. Y. A new flanged all-metal Bayard-Alpert type ionization gage with non-burnout iridium filament (FG-200), or double tungsten filament (FG-200-T) is now available. Type FG gage is claimed to be an ideal measuring instrument both in the high vacuum region (1 micron and less) and in the ultra-high vacuum region below 10^{-8} mm Hg. **Circle 320 on Reader Service Card.**



Punched Mica in many forms

FORD RADIO & MICA CORP., 536 63rd St., Brooklyn 20, N. Y. Natural "muscovite" mica, a material with unusual dielectric and thermal properties, can now be obtained in a wide variety of forms and dimensions. Paper-thin shims, washers, as well as complex, multi-holed, eyeleted fabrications and

MEMO

Bill

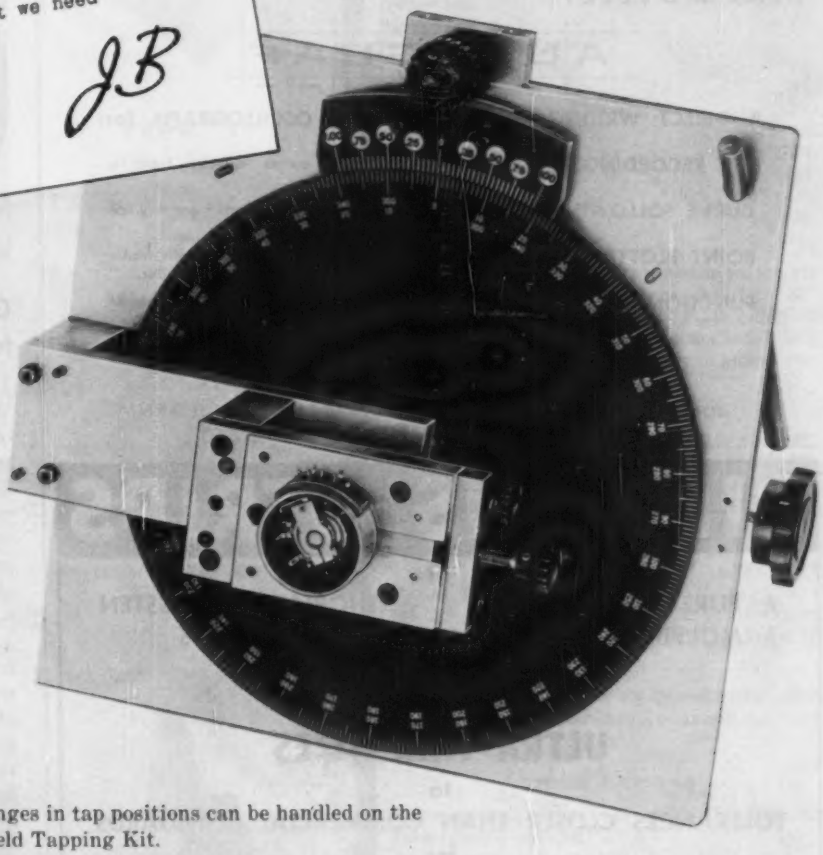
How about this--all we need with this kit are a couple of screwdrivers and tweezers to set taps in the field --no drilling or glueing to mess up the pot either.

Charlie says this vernier dial will give us precision adjustments to any angle.

Let's write for additional info-- it may be exactly what we need to reduce down time.

JB

Adjustable potentiometer taps quickly and easily located with new DeJUR FIELD TAPPING KIT



Replacement of pots or changes in tap positions can be handled on the spot with DeJUR's new Field Tapping Kit.

You place the pot in the tap-setting fixture and insert the tap brackets at any desired angle. Tap brackets are supplied in many sizes and shapes for complete flexibility, and are secured by a set screw in the patented Universal Tap Mounting Ring*. Three taps can be installed as close together as desired—EVEN ZERO DEGREES APART! Minor adjustments can be made easily after the angle setting has been determined.

This simplifies assembly and reduces stock requirements to a few basic potentiometer sizes, the Universal Tap Mounting Ring and a variety of tap brackets.

For complete details or a demonstration, write to Electronic Sales Division, DeJUR-Amsco Corporation, 45-01 Northern Boulevard, Long Island City 1, N. Y.

*U. S. PAT. #2,619,570

You're always sure with

DeJUR

electronic components

MANUFACTURERS OF PRECISION POTENTIOMETERS FOR OVER 30 YEARS.

THE MOSELEY

AUTOGRAF

A DIRECT WRITING, LOW FREQUENCY OSCILLOGRAPH for:

X-Y RECORDING—Automatically draws curves directly from a variety of electrical data.

CURVE FOLLOWING—With adaptor, regenerates functions from original curves traced with conducting ink.

POINT PLOTTING—Plots points directly from Keyboard; with translator, plots from Card Punch or Tape Reader.

FUNCTION vs TIME—Automatically plots dependent variable against TIME. (5 Sweep Ranges)

Send for detailed specifications:

F. L. MOSELEY CO.

409 N FAIR OAKS AVENUE, PASADENA, CALIFORNIA

CIRCLE 239 READERS SERVICE CARD

RIBBONS · STRIPS

of

★ PURE TUNGSTEN ★ THORIATED TUNGSTEN
★ MOLYBDENUM ★ SPECIAL ALLOYS

and OTHER METALS

IN

ULTRA THIN SIZES

to

TOLERANCES CLOSER THAN COMMERCIAL STANDARDS

by

OUR SPECIAL ROLLING TECHNIQUE

Note: for highly engineered applications—strips of TUNGSTEN and some other metals can be supplied

ROLLED DOWN TO .0003 THICKNESS

- Finish: Roll Finish—Black or Cleaned
- Ribbons may be supplied in Mg. weights if required

For HIGHLY ENGINEERED APPLICATIONS

DEVELOPED AND MANUFACTURED BY

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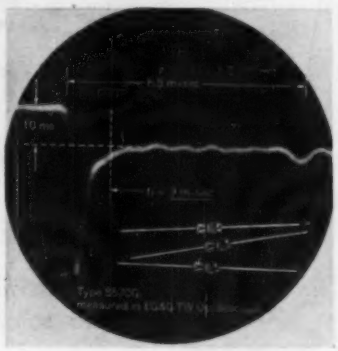
combinations with other materials are being produced for the electronics, instrument and guided missile fields. Some simple and complex insulating parts are being punched from mica in thicknesses as low as 0.001 in. **Circle 321 on Reader Service Card.**



Germanium Diode fast switching

TRANSITRON ELECTRONIC CORP., Wakefield, Mass. Switching time of 0.9 millimicrosecond has been achieved by a new germanium diode, the S570G. It is suitable for use in extremely high speed transistorized circuitry. New manufacturing techniques have resulted in a stored charge (after a 10 ma forward current) smaller than that of a 3 $\mu\mu$f capacitor at 6 v. Intended for critical computer applications at normal transistor bias levels, these diodes can simplify circuitry and reduce the number of transistors needed. **Circle 322 on Reader Service Card.**

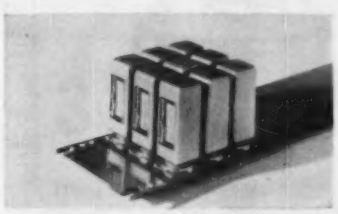
Silicone Sponge complex shapes

THE STALWART RUBBER CO., 376 Northfield Road, Bedford, Ohio, has perfected a technique for extruding and calendering complex silicone sponge shapes. Company can supply extruded silicone sponge

cross-sections in long lengths, continuous lengths, coils and rolls. Sheets of silicone sponge up to 36 in. wide can be produced by the calendering method. Besides enabling manufacturers to save in production costs, these silicone sponge parts provide high resistance to aging, sunlight, and ozone, plus excellent dielectric qualities at extremely high temperatures. **Circle 323 on Reader Service Card.**

Crystal Filters in 5 bandwidths

Bulova Watch Co., 42-06 62nd St., Woodside 77, N. Y. Five bandwidths are available in the new A series 10.7 mc crystal filters. These bandwidths at the 3 db points are 15 kc, 20 kc, 30 kc, 40 kc and 50 kc wide, with the shape factor to the 60 db points better than 2:1. The miniature size, hermetically sealed filters find applications as i-f filters, carrier pickoffs, in telemetering, personal message signalling service and radar. **Circle 324 on Reader Service Card.**



Logic Blocks save space, costs

Epsco, Inc., 588 Commonwealth Ave. Boston 15, Mass., has available a complete line of transistor digital circuits in two package styles and three temperature ranges. Package style A (illustrated) is for mounting in 9 and 14 pin miniature tube sockets. Package style B is for 15 pin in-line mounting. The three

microwave absorbers by McMillan

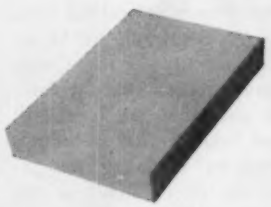
McMillan Industrial Corporation makes various materials for the absorption of microwave energy, for indoor or outdoor use and for ground or airborne applications. Listed below are the three most popular absorbers, their typical applications, specifications and characteristics.

TYPE "T"
THIN — FLEXIBLE

Especially adaptable for airborne applications, the type "T" is an extremely versatile absorber where space and weight limitations are essential. Easily formed, it is impervious to effects of moisture, hydraulic fluids, gasoline etc., when edge sealed.

SPECIFICATIONS

Frequencies:	2500 to 35,000 MC.
Bandwidth:	±3%
Power Reflection Coefficient:	
Perpendicular Polarization	1%
Parallel Polarization	2%
Perpendicular & Parallel Polarization	2%
Power Dissipation:	2 watts/sq. in.
Temperature Range:	—62°F to 172°F
Thickness & Weight:	at 9375 MC., 3/16" thick, 4.7 oz./sq. ft. at 5400 MC., 1/4" thick, 5.7 oz./sq. ft.
Standard Sheet Size:	18" x 36"



TYPE "BL" & "BH"
PERMANENT — LIGHTWEIGHT

Two stable absorbers whose high performance and long life is not affected by moisture, humidity and dust. Type "BL" is fine for walls, ceilings and test panels. Type "BH" is excellent for test room floors and outdoor installations, as its high absorption characteristics are unchanged when it is walked on.

SPECIFICATIONS

Frequency range:	1000 to 35,000 MC.
Power reflection coefficient:	0.4% at 24,000 MC.
(perpendicular and/or parallel	1.0% at 9,400 MC.
polarization)	2.0% at 5,400 MC.
Power dissipation:	2 watts/sq. in.
Temperature range:	(type "BL") —62°F to 155°F
	(type "BH") —62°F to 175°F
Standard block size:	2" or 4" thick, 4' long, 1' wide
Weight:	(type "BL") .5 lbs./sq. ft.
	(type "BH") .7 lbs./sq. ft.

TYPE "BL-48"
BROADBANDED — PERMANENT

Recommended for use in the low frequency range where permanent attenuation characteristics are required, for both indoor and outdoor applications.

SPECIFICATIONS

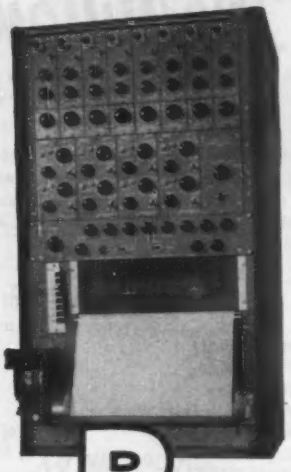
Frequency range:	40 to 35,000 MC.
Power reflection coefficient:	2½%
(perpendicular and/or parallel polarization)	
Power Dissipation:	2 watts/sq. in.
Size:	Base — 1' x 2'
	Height — 48"
Weight:	5 lbs./sq. ft.
Temperature range:	—62°F to 155°F

Also available — Type "H" Hair Mat Absorbers in thicknesses from 1" to 8" for frequencies from 500 to 35,000 MC

McMillan

McMILLAN LABORATORY, INCORPORATED
Brownville Avenue • Ipswich, Massachusetts

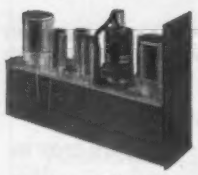
OFFNER
All Transistor



TYPE R
DYNOGRAPH

A direct-writing oscillograph with unmatched features of superiority! Whatever your application for direct-writing recording, the Offner Type R All Transistor Dynograph will do your job *better* and more *easily*. Write on your letterhead for literature and complete specifications.

TYPE 190 *Differential*
DATA AMPLIFIER



Zero-drift d-c amplifier with 1/100% accuracy. Linearity of better than 0.05%. Gain stability of 0.01%. Ripple of less than 0.1%. Infinite rejection of common d-c signals. Rapid response to step input. Ambient range −67°F to 170°F. Ask for Bulletin 572.

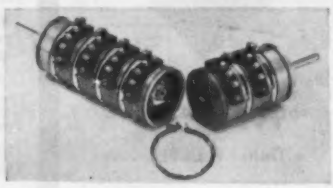
Type 542 Two-Channel
DYNOGRAPH

Rapid response, high sensitivity, stability, compact construction, economical price—all features that make this all transistor, 2 channel unit ideal as a test instrument . . . practical for use at every laboratory bench. Ask for Bulletin 181.

OFFNER
ELECTRONICS
3906 River Road, Schiller Park, Ill.
(Suburb of Chicago)

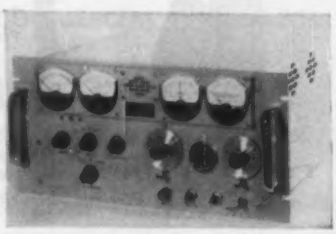
CIRCLE 99 READERS SERVICE CARD

available temperature ranges are: −10 to +60 C, −10 to +71 C, −55 to +71 C. The circuits are conservatively designed for 100 kc operation, but permit operation to 200 kc, and in some cases, up to 400 kc. Cost of the circuits ranges from approximately $25 to $45 for quantities less than 10 and from approximately $15 to $30 for larger quantities. **Circle 325 on Reader Service Card.**



Change-Quick Pots
linear, nonlinear

ACE ELECTRONICS ASSOCIATES, INC., 99 Dover St., Somerville 44, Mass., has developed its Change-Quick potentiometers to simplify replacement of potentiometer functions. Individual function cups are quickly substituted by removing the external clamp, fitting the new cup into position, two simple operations of indexing and phasing, and replacing the clamp. All cups of a seven-gang assembly can be indexed and phased in minutes, with shaft rotation alignment error of less than 0.1 deg. Pots are available in linear and nonlinear, in all AIA sizes. **Circle 326 on Reader Service Card.**



Telemetry Receiver
phase-lock type

NEMS-CLARKE CO., 919 Jesup-Blair Drive, Silver Spring, Md. The 1400 series phase-lock receivers cover frequency ranges of 215 to 260 mc. Phase-lock improves data accuracy under weak signal conditions by lowering the receiver threshold and creating an overall improvement in signal-to-noise ratio. **Circle 327 on Reader Service Card.**

D-C Voltmeter
all-transistor

CONSOLIDATED ELECTRODYNAMICS CORP., 300 N. Sierra Madre Villa, Pasadena, Calif. Model 30A d-c electronic voltmeter is designed to measure low-level potentials inherent in transistor and diode circuitry. Its eight ranges permit measurements from 0.05 to 150 v with accuracy of ± 3 percent full-scale. The all-transistor instrument uses printed wiring to get compact size (6 by 8 by 6 in.) and light weight (10 lb.). **Circle 328 on Reader Service Card.**

Vibrating Capacitor
high stability

TRACERLAB, INC., 1601 Trapelo Rd., Waltham 54, Mass. A new vibrating capacitor, engineered for industrial use, is minimally affected by temperature changes over a broad thermal range and requires no shock mounts. Among its distinctive features is overall steel

3 New Midget Pliers by KLEIN

Here is a new line of genuine Klein Pliers in oblique and long nosed patterns specially designed for wiring modern electronic assemblies or doing any close work in confined space.

These midgets are hardly longer than your favorite package of cigarettes and their extremely small size will simplify many small close-tolerance jobs.

Available in oblique cutting, long nose with and without knurl, and end cutting pliers.

See your distributor.

No. 257-4 Oblique Cutting Plier.	Size 4 in.
321-4½ Long Nose Plier	4½ in.
322-4½ (Without Knurl)	4½ in.
224-4½ End Cutting Plier	4½ in.

Available with coil spring

No. 257-4C Oblique Cutting Plier	
321-4½C Long Nose Plier	
322-4½C (Without Knurl)	
224-4½C End Cutting Plier	

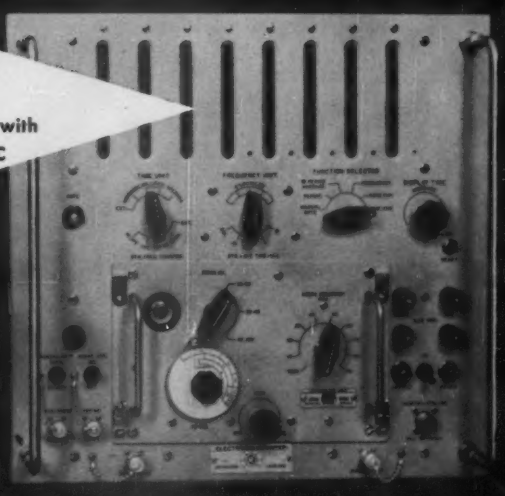
Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

Free Bulletin on Klein Pliers
Bulletin 758 on Klein Pliers sent you on request.

For Frequency Measurement, Counting, Periods, Time Intervals . . .

ELECTRONIC COUNTERS

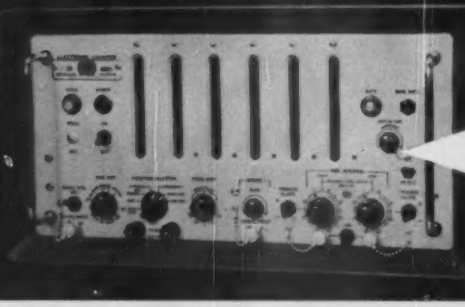
MODEL 14-20A
$1,700
10 cps to 10 MC with Plug-Ins to 220 MC



NEW– Advanced Circuitry

NEW– Mechanical Design.

NEW HIGHS in STABILITY and ACCURACY
Yet at New LOWS in COST!



MODEL 13-20
$995
10 cps to 1.1 MC

BOTH MODELS available with optional Transistorized Oscillator: Stability 5 parts in 10^8 per week; and 5 parts in 10^8 per month thereafter; at nominal additional cost.

NORTHEASTERN ENGINEERING, INC.
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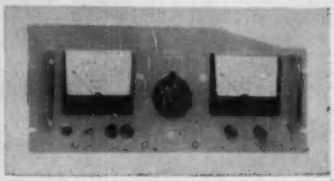
P. O. Box 150 • NAtional 2-6485

housing with the capacitor assembly hermetically sealed and filled with inert gas to minimize drift in constant potential. The magnetic driver unit is mounted outside the seal and is completely shielded from the capacitor assembly. **Circle 329 on Reader Service Card.**



Power Supply chopper stabilized

HYPERION, INC., West Newton, Mass. For strain gage applications model HY-CA1-10-10 transistorized power supply is chopper stabilized. Input is 105-125 v; output, 1-10 v d-c, 10 amperes. Regulation for all possible combinations of line variation, load variation and voltage setting is less than 1 mv. Ripple is less than 1 mv. Temperature coefficient is less than 0.0025 percent per deg C between 5 C and 45 C ambient temperature. Price is $895. **Circle 330 on Reader Service Card.**

UHF Cavity Filter features low loss

ADAMS-RUSSELL CO., INC., 292 Main St., Cambridge 42, Mass. A new tunable uhf cavity filter is announced. The cast aluminum cavity is silver plated for low loss and pressure-tight to prevent the en-

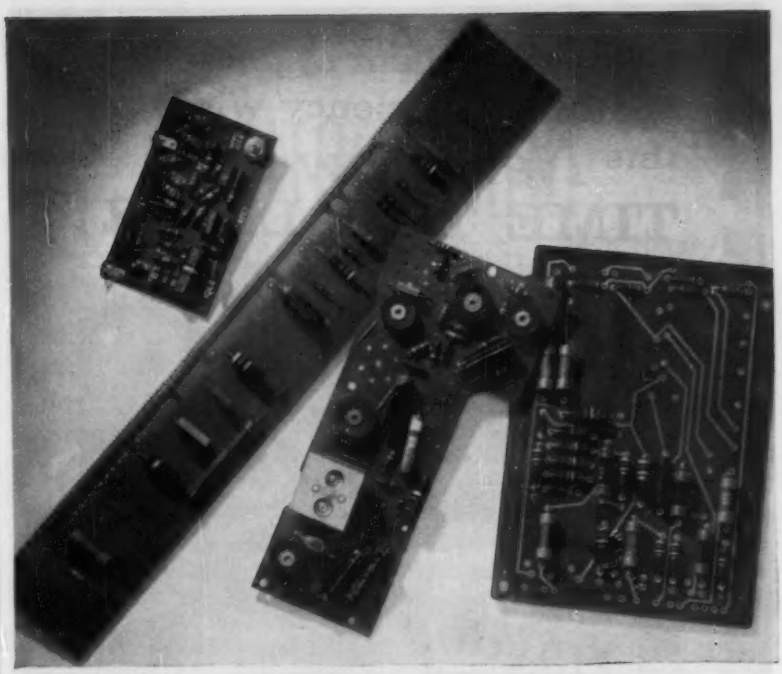
trance of moisture and dust. Model 210 covers the frequency range of 200-420 mc and has a power rating of 300 w c-w. This filter provides: reduced interference between adjacent transmitter-receivers operating in same location; preselection for receivers with reduced images and other spurious responses; reduced harmonic radiation from transmitters; and the capability to multiplex several receivers or transmitters into a common antenna. **Circle 331 on Reader Service Card.**

Digital Ohmmeter transistorized

ELECTRO INSTRUMENTS, INC., 3540 Aero Court, San Diego 11, Calif., announces a new five-digit ohmmeter, the DOA-500. Consisting of a universal power module and a resistance switch module, it is totally transistorized and is part of a complete new line of modular digital instruments. Unit is accurate to 0.01 percent, ±one digit, from 000.01 ohm to 9.999 megohms. Ranging is automatic. Average readout time is only 1.5 sec. **Circle 332 on Reader Service Card.**

Rotary Switch for p-c mounting

P. R. MALLORY & CO., INC., Frankfort, Ind., has developed a new multiple-position rotary switch designed for mounting directly on printed circuit boards, without



DYNASERT®

Component Inserting

Economical for long or short runs, all board sizes

No. 1 Dynasert Component Inserting Machine Model B

Jumper Wire Inserting Machine Model B

No. 3 Dynasert Inserting Machine Model B

Dynasert users are finding mechanized component assembly practical for processing printed wiring boards in lots of 100, 75 — even as few as 20 a week!

There are two reasons why.

The first is *economy*. Mechanized assembly gives production rate advantages ranging as high as 8 to 1 over hand assembly.

The other reason users like Dynasert is *reliability*. They can count on uniform trimming, inserting and clinching without strain on component leads.

If you are now processing, bidding on or planning production that uses printed wiring, find how Dynasert can be of help.

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140 Federal Street, Boston 7, Massachusetts
Gentlemen:
☐ Please send me your illustrated booklet "Dynasert Production Equipment for Electronics."
☐ Please have representative call to tell us how we may use mechanized assembly.

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Keep equipment at peak operating efficiency with this *New, Low-Cost* **TIME TOTALIZER!**

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- **DIRECT READING COUNTER . . .** accurately records operating time in hours and tenths up to 9,999.9.
- **SMALLER, LIGHTER . . .** than any other commercial unit. Weighs 5 ounces. Overall length only 2½".
- **RUGGED . . .** withstands heavy shock and vibration. Operates over a temperature range from −55°C to +71°C. Case is dust-tight and oil-tight.
- **LOW POWER REQUIREMENT . . .** 2.5 watts at 120 vac.
- **COMPLETELY DEPENDABLE . . .** utilizes the well known Haydon Timing Motor.
- **AVAILABLE . . .** for 60 cycle operation at 120 or 240 vac.

The low cost of this new Series ED-71 Elapsed Time Indicator makes it possible to provide an economical, accurate record of operating time for machine tools, communications equipment and practically any other type of industrial or commercial installation. Insures accurate scheduling of maintenance, tool changes and parts replacement. Helps to keep operating efficiency at a maximum . . . operating and maintenance costs at a minimum. Other Haydon Elapsed Time Indicators of similar size and weight are available for military applications.

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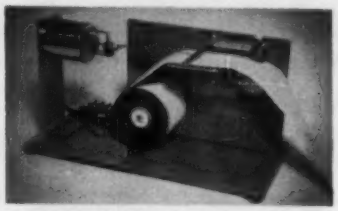
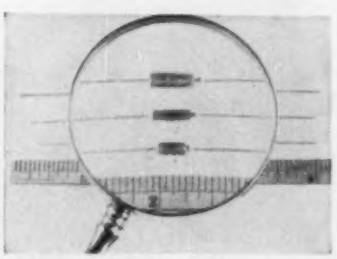
HEADQUARTERS FOR TIMING

need for stand-off hardware or leadwires for electrical connections. Indicated uses include switching of meter circuits, signal selection, tone selection, bias selection, circuit sampling and other applications in commercial and military equipment using printed circuitry. **Circle 333 on Reader Service Card.**



Oscillograph
d-c to 60 cps

MANDREL INDUSTRIAL INSTRUMENTS, 5134 Glenmont Drive, Houston 36, Texas. Model ER-22 direct-writing oscillograph will record signals from d-c to 60 cps. Available with coil resistances from 215 to 4,000 ohms and with a resonant frequency of 30 cps, the pen galvanometer features a spring-leaf flexure and "voice-coil" design for extreme ruggedness and freedom from "stiction". 100 ma through a 215-ohm coil provides a full-scale deflection of 40 mm with 2 percent linearity. A wide range of chart speeds is achieved by simple, inexpensive clip-in motors. Price is $97.50. **Circle 334 on Reader Service Card.**



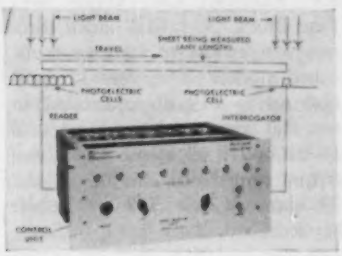
Tantalum Capacitors
sintered anode

MINITRONICS CORP., 328 Grand St., New York 2, N. Y., announces a line of sintered anode subminiature tantalum capacitors. They operate over a range of −80 C to

+85 C. TQ capacitors are extremely rugged and stable and meet the environmental specifications of MIL-C-3965. They are available in capacities of 47 μf at 6 v and 6.8 μf at 35 v. **Circle 335 on Reader Service Card.**

Power Resistors wirewound

OHMITE MFG. CO., 3699 Howard St., Skokie, Ill., has available new, wirewound power resistors in 3, 5 and 10 w sizes. They feature a jacket of Silicone-ceramic material molded around the resistor to provide a uniform, moisture-proof, high insulation resistance covering. **Circle 336 on Reader Service Card.**



Miscut Gage ± 0.003 in. accurate

ELDORADO ELECTRONICS, 2821 Tenth St., Berkeley 10, Calif., has developed a new control device for automatically measuring the length of steel sheets moving along a conveyor belt at up to 50,000 feet per minute and rejecting short or long sheets. It is also well adapted to nonferrous metal, plastic, paper, rubber, textile or other material fabrication processes where accurate dimensional control is desired. Approximate cost of the complete installation is $4,500. **Circle 337 on Reader Service Card.**

Phase Generator simple and rugged

THETA INSTRUMENT CORP., 48 Pine St., East Paterson, N. J., announces a line of passively constructed phase generators. The devices are used to measure phase shift

AUTOMATION

the modern way to cut costs... save time

Latest in Coil Winding Equipment Company's wide variety of high-speed coil winders for all possible needs is the Model CK, designed to take maximum advantage of the time and money saving principles of automation. The Model CK meets most applications, minimizes maintenance, and cuts down considerably on the need for special-purpose, custom-built equipment.

MODEL CK

The Model CK features Coil Winding Equipment Company's recently-developed turret transfer. In combination with a suitable winding head, the ingenious turret transfer permits adding — *only as needed* — hopper feed for the coil forms; stripping, cementing, taping and cutting attachments. The Model CK will produce complete bobbin or single-layer coils without operator attention when equipped with a hopper or magazine for the coil forms and appropriate standard attachments, and it will provide stations for finishing as required.

We'll be pleased to send you complete information. Write or phone

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how to machine .006" thick glass cams to .001" tolerances

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Everyday "problem" cutting jobs are becoming routine thanks to the S.S.White Industrial Airbrasive Unit.

A typical example of the type of work the Airbrasive Unit can do is the glass cam shown in actual size above. This piece is used on military aircraft in a metering device. The cam, made of glass .006" thick, has to be cut to tolerances of .001". "With the Airbrasive Unit, we met these requirements with ease, without shattering or splitting the glass," states the manufacturer, Fish-Schurman, New Rochelle, N. Y.

On this and many other products including potentiometers, printed circuits, transistors, vacuum tubes, small steel needles, resistors, etc., the Airbrasive Unit is ideal. It gas-propels a fine stream of abrasive that cuts, abrades, deburs, removes surface coatings. Hard, brittle materials will not shatter; softer materials—including human skin—are unharmed. The Airbrasive Unit may well be the answer to your problem cutting jobs. Write today for Bulletin 5705A.

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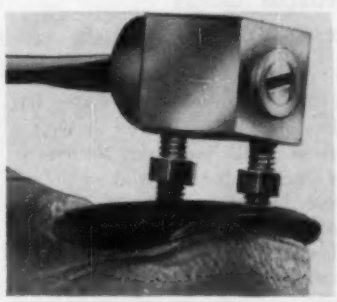
with 30-minute accuracy, provide reference voltage to demodulator and modulator circuits. As a shaft angle to time phase transducer it also finds application in servo systems. **Circle 338 on Reader Service Card.**

Attenuators three new models

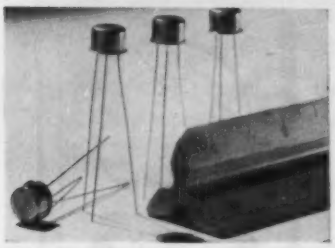
KAY ELECTRIC CO., Maple Ave., Pine Brook, N. J., has added three new attenuators to its nine established models. They offer attenuation up to 119 db controlled by two dial-type switches calibrated in 10 db and 1 db steps. Input and output impedances are 50, 70 and 90 ohms. **Circle 339 on Reader Service Card.**



Potentiometers trimmer type

MINIATURE ELECTRONIC COMPONENTS CORP., Holbrook, Mass. Designed for horizontal-mounting applications, these trimmer pots which measure only ¼ in. square and ⅜ in. long are engineered and tested for operation under environmental extremes of heat, cold, humidity, vibration and shock encountered in airborne and missile applications. Available for stud-mounting (model MS-4) and lead-

mounting (model MS-5) on printed wiring boards, both models feature low temperature coefficient resistance wire, precious metal wiper, Mylar and Teflon insulation. Units are rated at ¼ w and are available in standard resistance values from 100 ohms to 10,000 ohms. **Circle 340 on Reader Service Card.**



Transistors h-f switching type

MOTOROLA INC., 4545 W. Augusta Blvd., Chicago 51, Ill., has announced a new line of germanium h-f switching transistors. To be marketed under EIA numbers 2N425, 2N426, 2N427 and 2N428, the new product line features the standard TO-9 package and is designed to meet or exceed the electrical and mechanical requirements of MIL-T-19500A. **Circle 341 on Reader Service Card.**

Transistor Protector fast response time

ELECTRONIC RESEARCH ASSOCIATES, INC., 67 Factory Place, Cedar Grove, N. J. The RV30 transistor circuit protector is interposed between the load circuit and power supply and effectively disconnects the circuit in the event of either over-voltage or excessive current condition. Specifications include an over-voltage adjustment range of

THOMPSON PRODUCTS NEEDED A HEATER FAST...

Here's how General Electric solved customer's heating problem—in 3½ days!

Recently, Thompson Products, Inc., ran into a problem: components were not available which would function at the extremely low temperature ambients required for a control being manufactured for a new USAF fighter. A holdup here could halt the entire aircraft program.

A General Electric sales engineer was called in. To General Electric's Specialty Heating Products plant at Coxsackie, N. Y. went a call. Asked the customer: "How soon can you design, develop and deliver a prototype heater for our airborne system component?" The General Electric answer "78 hours — 3½ working days—after we receive your specs."

Project preparations started immediately. When the rough equipment sketches arrived, the team went into action. At 11:00 A.M. Thursday — 3½ days later — the heating unit passed final inspection; was on its way. Final result: the aircraft program never slowed down.

THIS IS ONE EXAMPLE of how quickly General Electric can solve straight forward thermal conditioning problems. When you have a heating problem, call in your nearest General Electric sales engineer.

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Please send bulletin GEA-6285A, G-E Specialty Heating Equipment
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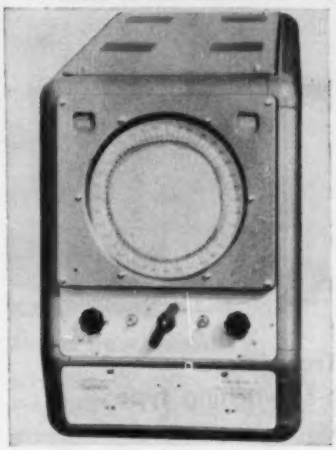
Leading electrical/electronic manufacturers throughout the country are using hundreds of Markem machines for faster, *better* marking. You can, too. Ask Markem for recommendations; enclose samples (if possible) to be marked. New catalog describes all machines for electrical/electronic industries, shows typical items marked. Write Markem Machine Co., Keene 5, N. H.

MARKEM

5-50 v d-c, over-current adjustment range of 100 ma-1 ampere. Pass current is 0-1 ampere. Voltage drop within the unit is less than 0.4 v. Response time of the unit is approximately 25 μsec. **Circle 342 on Reader Service Card.**



Automatic VHF D/F low-cost unit

Ekco Electronics Ltd., Southend-on-Sea, England, has announced the CE178 automatic vhf direction finder. It is designed to show the sensed bearing of a transmission on any one selected frequency in the 118-132 mc band. Intended for the improvement of air traffic control, the equipment is claimed to have passed more than 50,000 bearings during a 6,000-hr test at England's second busiest airport. Maximum range is about 100 mi for an airplane flying at 10,000 ft radiating 5 w. Probable error is said to be 0.5 deg with maximum error under 2 deg. **Circle 343 on Reader Service Card.**

Magnetic Shield for twt's

Magnetic Shield Division Perfection Mica Co., 1322 N. Elston Ave., Chicago 22, Ill., announces the multiple function non-shock sensitive non-retentive dual Netic magnetic shield for traveling wave tubes. It is designed to provide more uniform cooling as well as to direct the magnetic field developed

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SINTERED STEEL BOND
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(FOR WET GRINDING)

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Metal-bonded quality products

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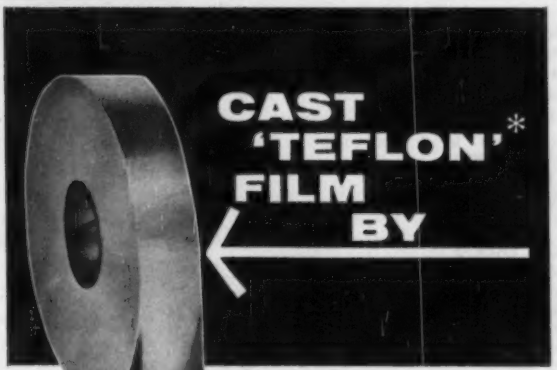

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DILECTRIX

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*Trademark du Pont "Teflon" TFE resin

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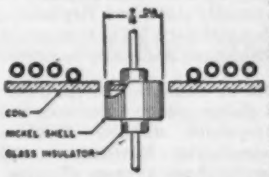
The Lepel line of induction heating equipment represents the most advanced thought in the field of electronics as well as the most practical and efficient source of heat yet developed for industrial heating.

If you are interested in induction heating you are invited to send samples of the work with specifications. Our engineers will process and return the completed job with full data and recommendations without any cost or obligations.

TYPICAL INDUCTION HEATING APPLICATIONS IN THE MANUFACTURE OF TRANSISTORS

SOLDERING TRANSISTOR ASSEMBLIES BY INDUCTION HEATING

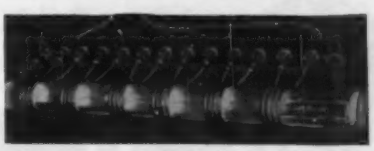


Concentrator-type coil creates high intensity, restricted heating at joint of nickel shell and tinned glass, thus causing solder to flow for permanent seal.

SINGLE CRYSTAL PULLER

General arrangement for pulling single crystals. Induction heating coil is shown surrounding quartz tube containing crucible with molten germanium in suitable atmosphere.

MULTIPLE ZONE REFINING



Induction heating apparatus used in zone refining. The six coils shown provide simultaneous molten zones in the ingot as it passes through the tube containing the protective atmosphere.

Electronic Tube Generators from 1 kw to 100 kw.
Spark Gap Converters from 2 kw to 30 kw.

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RESISTANCE NETWORKS

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FROM A RELIABILITY STANDPOINT, use of sealed networks is recommended in preference to individual resistors to eliminate harmful preventive maintenance. In field servicing the technician is often not aware of the precise T.C. and reactance matching of otherwise seemingly ordinary MIL resistors. In addition to special winding techniques the individual resistors in critical networks are usually stabilized. Replacement of any resistor with a standard MIL type could cause equipment malfunction, and must be prevented.

FROM A DESIGN STANDPOINT Shallcross' skill and ability assure adherence to the most exacting temperature, stability, shock, size, and weight requirements. Shallcross precision engineered networks have proven effective both in ground-based and airborne equipment.
Two typical Shallcross resistance networks are described below. Many others with specialized electrical and mechanical characteristics are regularly manufactured.

SECONDARY-STANDARD VOLTAGE REFERENCE SOURCE is built around this 24 terminal Shallcross resistance network. Using an oil-filled enclosed network of 21 matched T.C. resistors with stabilities of 0.001%, the instrument maintains an absolute accuracy of 0.01% from 0° to 50°C.

Shallcross

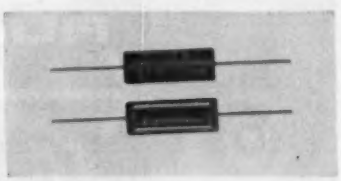
GROUND-SUPPORT COMPUTERS employ a number of these hermetically-sealed, standard, octal, plug-in networks. Networks have up to 10 specially wound resistors which are critically located and lead-dressed to meet specifications at 400 cycles. All units are production tested for voltage division accuracy and quadrature error using a precise 400 cycle bridge.

SHALLCROSS MANUFACTURING COMPANY • SELMA, N. C. New Address

by the enclosed solenoid structure and to act as a diversionary shield for fields originating in associated equipment. **Circle 344 on Reader Service Card.**

Junction Transistor *pnp* type

RADIO CORP. OF AMERICA, Somerville, N. J. As an a-f driver amplifier in class A service with a d-c supply voltage of −14.4 v, the 2N591 transistor can provide a power output of 5 mw with a total harmonic distortion of only 3 percent. At this power output, the 2N591 has a power gain of 41 db. The unit is a germanium alloy-junction transistor of the *pnp* type. It has a maximum peak collector-to-emitter voltage of −32 v and a maximum collector dissipation of 100 mw at an ambient temperature of 55 C and with a suitable heat sink. **Circle 345 on Reader Service Card.**



Metal Film Resistor miniaturized

WESTON INSTRUMENTS DIVISION of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N. J., has added a new, smaller Vamistor to its line of precision metal film resistors. Model 9855 was specially designed for use in transistor circuits, aircraft and missile gear, computers, and other high quality instruments requiring a high degree of miniaturization. Rated at ¼ w at 125 C (derated to 0 at 190 C) this Vamistor is 0.650 in. long and 0.235 in. in diameter. It is available in

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Circle No.	Products *

INSIDE FRONT COVER INSIDE BACK COVER

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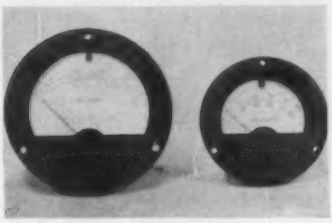
values between 250 ohms through 500 K at tolerances of 0.25, 0.5 and 1 percent. Standard maximum temperature coefficient of these thermally fused resistors is ±50 ppm per deg C. **Circle 346 on Reader Service Card.**



Panel Meters ruggedized

WacLine, Inc., 35 So. St. Clair St., Dayton 2, Ohio, has developed an additional line of round ruggedized and sealed electrical indicating panel meters having external zero adjusters, to meet the requirements of MIL-M-6B and MIL-M-10304A. A unique locking seal is employed between the case and bezel, and a positive neoprene gasket sleeve effectively seals the zero adjuster from moisture leakage. The entire movement is isolated in rubber and the glass window is double strength to provide maximum protection from shock and vibration. Meters are currently available in d-c and a-c types in 2½ and 3½ in. sizes. **Circle 347 on Reader Service Card.**

Transistor Oscillator sturdy unit

Di-An Controls, Inc., 40 Leon St., Boston 15, Mass. Suitable for extreme environments, a new transistor oscillator provides a 1¼ v peak-to-peak 17 kc sinewave output with less than 1 percent distortion. Frequency stability is better than ±0.05 percent from 0 deg F to 140 F. A three-minute exposure to 250 F ambient temperature will not cause frequency deviation to exceed 0.1 percent. Unit withstands 12 g vibration from 40 to 2,000 cps and 100 g shock. Size is 3 in. by 1 in. by 1 in.;

NOW...
IMMEDIATE DELIVERY
ON LEDEX® ROTARY
SOLENOIDS!

The following popular models of LEDEX Rotary Solenoids will be shipped the same day or the day after receipt of order . . . in quantities up to 9 of each model.

MODELS AVAILABLE WITH . . .

Three tapped holes in armature plate and scroll type return spring . . . or

shaft extension armature end, dust cover and scroll type return spring

. . . or shaft extension base end, dust cover and scroll type return spring

MODEL NUMBER	ROTATION R OR L	TORQUE VALUES POUND INCHES
BD1E	25°	.34
	45°	.10
BD2E	25°	.54
	45°	.24
BD3E	25°	1.18
	45°	.68
	67½°	.28
BD4E	25°	2.92
	45°	1.22
	95°	.32
BD5S	25°	7.05
	45°	3.15
	95°	.60

28 D.C. OR 115 A.C. RECTIFIED

LEDEX®

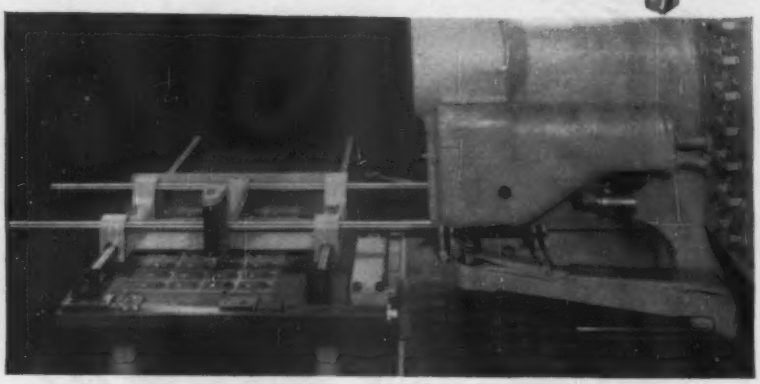
WRITE FOR BULLETIN 10-57-S
contains complete engineering data on all models available for immediate delivery

G.H. Leland INC.

123 WEBSTER STREET, DAYTON, OHIO

IN CANADA: Marsland Engineering Ltd., Kitchener, Ontario
IN EUROPE: NSF Ltd., 31-32 Alfred Place, London, England
NSF, GmbH, Further Strasse 101a, Nurnberg, Germany

drilling or die-stamping printed circuits?



cold-punch them for less on a

Strippit Fabricator-Duplicator

No matter how complicated the hole pattern, if it's a medium run within a capacity of ¼" mild steel, there's no easier or faster way than with a Strippit Fabricator-Duplicator!

No heat, no fixed dies, no drilling. And hole quality is uniformly good, with no crack formation in your laminates.

It's simple to operate — anyone can be hitting high production after a few minutes' instruction. Place master template in Duplicator. Place up to 15" x 25" circuit board or other work in Fabricator. Then, as you place the Duplicator stylus in each template pilot hole, the work is automatically positioned and the punch tripped. Tool changes are made in *seconds*, using the complete line of standard punch and die buttons in the Fabricator's handy "file drawers" — or special-shape tools can be made to your order.

Write today for engineering details and a demonstration at your plant. See how this machine could be cutting your costs — and paying for itself in a hurry under our pay-as-you-produce plan!

Warehouse stocks in Chicago and Los Angeles.

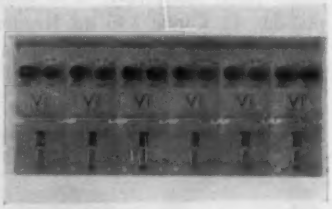
Wales STRIPPIT Company

A UNIT OF HOUDAILLE INDUSTRIES, INC.

225 Buell Road, Akron, New York

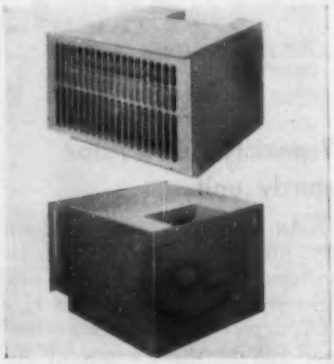
In Canada: Strippit Tool & Machine Limited, Brampton, Ontario

weight, less than 5 oz. Power required is 28 ± 3 v d-c at 12 ma. **Circle 348 on Reader Service Card.**



D-C Amplifier
1-kc bandwidth

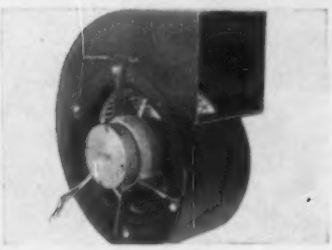
VIDEO INSTRUMENTS CO., INC., 3002 Pennsylvania Ave., Santa Monica, Calif. A new infinite input impedance d-c amplifier utilizes a novel solid state chopper. The model 74 converts d-c voltages to a-c voltages by means of a magnetostriction driven capacitor, named Delta C converter. This chopper provides the long term stability associated with chopper stabilized amplifiers, yet eliminates all the disadvantages of a mechanical device, such as contact wear, limitation in operating frequency, and adverse operation under shock or vibration. The 8 kc chopper frequency is well outside the bandwidth of the amplifier, thus avoiding chopper intermodulation. **Circle 349 on Reader Service Card.**



Rack Cooler
1,200 cfm unit

MCLEAN ENGINEERING LABORATORIES, P. O. Box 228, Princeton, N. J., announces a new recessed centrifugal blower designed specifically for computers, control panels,

telemetry cabinets and consoles that are densely packed with tubes, power supplies and other heat generating equipment. Model 1EB800G is said to provide a new high in heat dissipation for its size . . . 1,200 cfm, 19 in. panel width and only 10½ in. high. **Circle 350 on Reader Service Card.**



Cooling Blower 3 13/16 in. motor

AIR-MARINE MOTORS, INC., 369 Bayview Ave., Amityville, L. I., N. Y. The F frame cooling blowers are presently being used in large commercial computers to maintain normal power supply temperatures. The motors are mounted inside the impeller to reduce overall size and to obtain a cooling effect on the motor itself. Units can be supplied for military or commercial use in 115 or 220 v, 1 or 3 phase, 60 or 400 cps applications. The motor illustrated is 3⅛ in. in diameter and is driving an 8½ in. squirrel cage impeller. Operating from a 208 v, 3 phase, 60 cps supply it delivers 720 cfm at 0 in. static pressure and 500 cfm at 1 in. static pressure. **Circle 351 on Reader Service Card.**

Magnetic Cores aluminum-boxed

WESTINGHOUSE ELECTRIC CORP., Box 2099, Pittsburgh 30, Pa., an-

TELREX LABORATORIES

TWO WAY MOBILE RADIO DIVISION

Telrex "Beamed-Power" Base Station Omni-directional and High-gain Uni-directional Set-Up on One Support Structure

Special Diamond "E" Mech. Seamless Steel 1025, 80,000 P.S.I. Tensile (Available at Telrex in 6-24 ft. Lengths. 2" O.D. and .125, .158 and .250 Wall)

Telrex "Beamed-Power" Ground Plane Arrays (Send for Data Sheets)

Telrex "Beamed-Power" Twin Yagi Series (Send for Data Sheets)

Telrex Rotator and Direction Control Indication Systems (Prices on Request)

Special Hurricane Model 4 Post 50, 75 and 100 ft. Towers (Stocked and Available at Telrex. Other Heights Available on Special Order)

Telrex Ground Plane for General Coverage "Beamed-Power" Twin Yagi's for Gains of 8, 12 or more DB Depending on Frequency and Number of Elements

Modify existing troublesome installations or specify this special Telrex installation on your next troublesome prospect.

Makes your selling job easier by eliminating special extra height premium cost antenna sites. A rotated Twin Yagi will bring the signal to and from a poor site and allows use of shorter towers.

Telrex is equipped to design and supply to our specifications or yours, Broadband or single frequency, fixed or rotary arrays for communications, FM, TV, scatter-propagation, etc.

Consultants and suppliers to communication firms, universities, propagation laboratories and the Armed Forces.

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COMPLETE LINE for every Military and Special purpose . . . in PRODUCTION QUANTITIES . . . or CUSTOM DESIGNED to your specific requirement.

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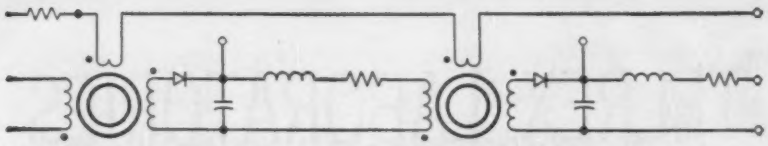

NEW HIGHER STANDARDS OF UNIFORMITY AND RELIABILITY IN BOBBIN CORES

...FOR COMPUTER APPLICATIONS

Now ultra-thin tape cores offer greater uniformity and reliability than ever before available. DYNACOR Bobbin Cores find ideal application in critical magnetic shift register, switching transformer and other logic circuits which require utmost uniformity in switching time and signal to noise ratio.

CHECK THESE FEATURES: RIGIDLY CONTROLLED 4-79 Molybdenum Permalloy Tape • Ceramic or Stainless Steel Bobbins • Hydrogen Atmosphere Annealing • Polyester Tape, Polyethylene or Nylon Protective Jackets • 100% Tested to Customer Specifications • Reliable Uniformity to Rigid Performance Specifications — on order after order—over long periods of time.

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Write for Bulletin DN-1000 and Engineering Data Sheets DN-1001 and DN-1002 for complete data. Address: Technical Literature Section, DYNACOR, INC., 10431 Metropolitan Ave., Kensington, Maryland.

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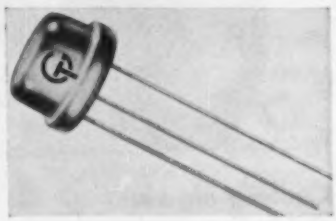
CIRCLE 216 READERS SERVICE CARD

TOUGH
and tiny
Save SPACE
and WEIGHT with
The A. W. HAYDON COMPANY'S unique Line of
RELIABLE SUB-MINIATURE REPEAT CYCLE TIMERS
TINY!
1 x 2 inch cross section
6½ ounce basic weight
Up to 10 switches
TOUGH!
Temperature: -54° C. to 85° C.
Vibration: 500 CPS, 10g
Shock: 30g
Hermetically Sealed Housings! Direct Current or 400 Cycle Operation! Custom Designed to Meet Military Specifications!
Write for Bulletin AWH-RC-301.
A.W. HAYDON Company
235 NORTH ELM STREET, WATERBURY 20, CONNECTICUT
Design and Manufacture of Electro-Mechanical Timing Devices

nounces a new Polyclad aluminum-boxed Hipermag toroidal core for magnetic amplifier applications. The new resin insulation eliminates core taping and provides an hermetic seal. Supplied in standard AIEE and other sizes, the new cores are made from one-, two-, and four-mil grain-oriented Hipernik V or one- and two-mil 4-79 Permalloy (HyMu 80). **Circle 352 on Reader Service Card.**



NPN Transistors high-voltage type

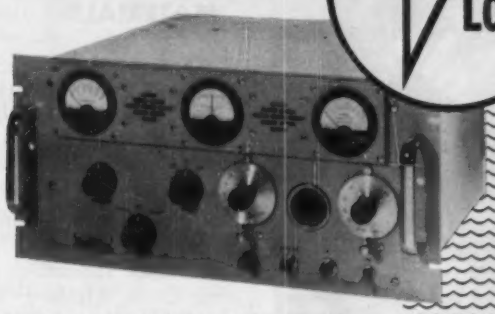
General Transistor Corp., 91-27 138th Place, Jamaica 35, N. Y., has available three new h-v *npn* transistors: types GT 1200, GT 1201 and GT 1202. They are especially useful as a driver for neon display tubes, high inductive loads and transformer coupled loads. They also allow more nearly perfect matching of high impedance loads. The GT 1200, 1201 and 1202 have collector and collector-to-emitter base voltages of 90 v, 75 v, and 45 v respectively. **Circle 353 on Reader Service Card.**

Polarized Relays fast action

The Hart Mfg. Co., 110 Bartholomew Ave., Hartford 1, Conn. Engineered to provide extremely fast action with freedom from bounce, together with high sensitivity and excellent stability, the series P polarized relays are designed to handle 500 pps, although under some conditions they will handle over 1,000 pps. Spdt, contact ratings will vary with switching speeds desired but range from 60 ma to 2 amperes with voltages up to 120 a-c or d-c. **Circle 354 on Reader Service Card.**

Latest Addition to NEMS • CLARKE RECEIVER LINE

PHASE LOCK



Now available in the Nems-Clarke line of telemetry receivers is the 1400 Series employing phase-lock detection. The receivers are of the double super-heterodyne type with a noise figure of less than 8 db.

The primary advantages of phase-lock when used as a wide band receiver demodulator is a lowering of the receiver threshold and an overall improvement in signal-to-noise ratio.

Frequency ranges determined by plug in crystals

Type 1420, 1421	215 to 245 mc
Type 1430, 1431	225 to 260 mc
Type 1432, 1433	215 to 260 mc

WORLD'S FOREMOST DESIGNERS AND MANUFACTURERS OF SPECIAL PURPOSE RECEIVERS

NEMS CLARKE COMPANY

A DIVISION OF VITRO CORPORATION OF AMERICA

919 JESUP-BLAIR DRIVE • SILVER SPRING, MARYLAND • JUNIPER 5-1000

CIRCLE 218 READERS SERVICE CARD

The tube that can transmit 100,000 telephone messages simultaneously!

THIS amazing electronic "workhorse" is a traveling wave amplifier tube—a broad band device, four feet long—pioneered by ITT for the Armed Forces.

Even in greatly reduced size it has enormous message-carrying capacity for all types of communications.

Traveling wave tubes are only one of numerous tube types manufactured by ITT Components Division—including transmitting, industrial power, rectifier, and memory tubes, and *Kuthe* hydrogen thyratrons for radar applications.

ITT Components Division—also a leader in semiconductors for two decades—is a top supplier of silicon and selenium rectifiers, as well as tantalum capacitors, contact protectors, and other components with many applications in aircraft, guided missiles, and similar vital areas.

With factories in Clifton and Newark, N. J. and Palo Alto, Cal. – and new facilities under construction in Roanoke, Va.—ITT Components Division offers an expanding field of opportunity for engineers experienced in its diversified production activities.

Qualified engineers are invited to inquire about present openings with ITT Components Division by writing to ITT Technical Placement Office, 67 Broad St., New York 4.

ITT COMPONENTS DIVISION

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For all loads up to 60 AMPS or 5 HP

FREE: Fully illustrated guide, now rated as the standard reference manual on types and uses of mercury plunger relays. Read about 1, 2, 3 pole hermetically sealed units that don't pit or corrode—need no maintenance.

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CIRCLE 219 READERS SERVICE CARD

PROVEN PERFORMANCE FROM SEA LEVEL TO 70,000 FT

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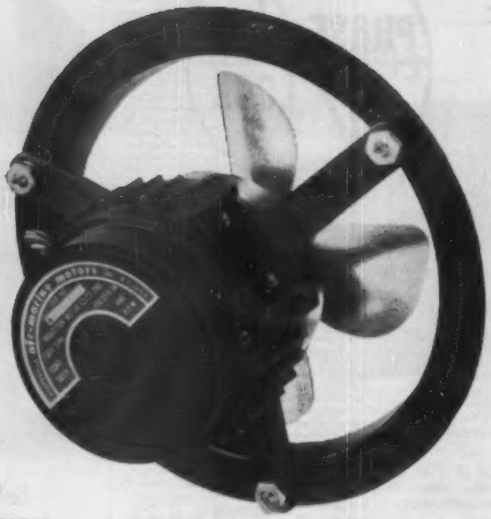
MAINTAINS CONSTANT COOLING EFFICIENCY



Mounting: 2½" across flats

NEW **IMPROVED HIGH SLIP MOTORS DRIVE COOLING FANS AT VARYING ALTITUDES**

New, improved, high-speed, high-slip motor design changes speed with lower densities (higher altitudes) to maintain constant cooling efficiency. These high-slip motors are rated at a minimum of 1,000 hrs. @ 125° C.; longer life expectancy at lower ambients. Choice of 400 cps or Variable at 1 ϕ, or 400 cps at 3 ϕ. Prototypes delivered in 2-6 weeks; Production deliveries 6-8 weeks. Circle card for data sheets and performance curves.

145 CFM at O"SP at Sea Level
440 CFM at O"SP at 70,000 ft.

AIR-MARINE MOTORS, INC.

air·marine motors, inc.

AMITYVILLE, NEW YORK • LOS ANGELES, CALIF.

Literature of

MATERIALS

Rare Earths. Nuclear Corp. of America, Inc., Research Chemicals Inc. Division, 170 W. Providencia, Burbank, Calif., has available small lot price lists for all the rare earth metals, oxides and salts. **Circle 375 on Reader Service Card.**

Silicone Insulation. Dow Corning Corp., Midland, Mich. Now available are new additions to the *Silicone Notebook*. They are identified as "Selection Guide to Silicone Insulating Components", "Specify Sylkyd Enameled Wire" and "Engineering Guide to Silicone Fluids". **Circle 376 on Reader Service Card.**

COMPONENTS

Terminal Chart. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass. A 21 by 27 in. wall chart, developed for quick reference, shows actual scale drawings, including dimensions and materials, of 60 of the most commonly used Cambion solder terminals. **Circle 377 on Reader Service Card.**

Unijunction Transistors. General Electric Co., Syracuse, N. Y., has published two new brochures containing specification and application information on silicon unijunction transistors. **Circle 378 on Reader Service Card.**

Variable Transformers. The Superior Electric Co., Bristol, Conn., has published a comprehensive catalog/reference manual which will serve as a guide for the selection and ordering of Powerstat variable transformers best suited for particular applications. **Circle 379 on Reader Service Card.**

Vibrating Capacitor. Stevens-Arnold, Inc., 7 Elkins St., South Boston 27, Mass. A new low drift vibrating reed capacitance modulator, which permits the measurement of currents as low as 10^{-16} ampere, is illustrated and described

the Week

in a four-page folder. **Circle 380 on Reader Service Card.**

EQUIPMENT

D-C Voltmeter. International Instruments Inc., P.O. Box 2954, New Haven 15, Conn., has published a new preliminary data sheet providing complete information and specifications on the recently developed model 1145 expanded scale d-c voltmeter. **Circle 381 on Reader Service Card.**

Panel Mounting Instruments. Trio Laboratories, Inc., Seaford, N. Y. Short form catalog 58-115 illustrates and describes a line of ten miniaturized, panel-mounting instruments which provide all the advantages of electronic voltage measurement and yet are so small and light that they are easily made a part of the equipment itself. **Circle 382 on Reader Service Card.**

Regulated Power Supplies. Sorensen & Co., Inc., Richards Ave., South Norwalk, Conn. A 2-page technical data sheet covers the Magnetic Rangers, models MR36-15 and MR 36-30. Units described are tubeless continuously-variable regulated 5-36 v d-c power supplies. **Circle 383 on Reader Service Card.**

Short Form Catalog. Weinschel Engineering, 10503 Metropolitan Ave., Kensington, Md. A 4-page folder illustrates and describes the company's coaxial step attenuators, modulated r-f sources, fixed coaxial attenuators, and insertion-loss measuring equipment. **Circle 384 on Reader Service Card.**

FACILITIES

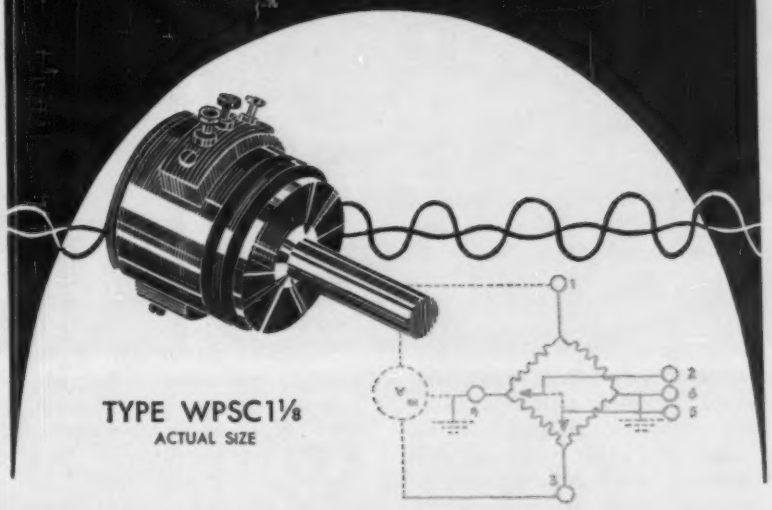
Facilities Brochure. Model Engineering and Manufacturing, Inc., 50 Frederick St., Huntington, Ind. A three-color, eight-page brochure provides general information on company purpose, direction, facilities, products and services now being offered. **Circle 385 on Reader Service Card.**

NEW...

Waters MINIATURE SINE-COSINE POT

gives the equivalent of . . .

3″ ACCURACY IN 1⅛″ DIAMETER



TYPE WPSC1⅛
ACTUAL SIZE

Designers of radar PPI displays and computer circuits, particularly, will welcome this new space-saving non-linear precision potentiometer. WPSC1⅛ provides two accurate and separate 360° sinusoidal output voltages displaced 90° in phase, representing the sine and cosine of the angle of shaft rotation.

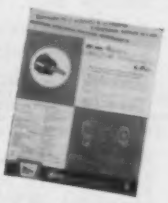
TERMINAL CONFORMITY is ±1% of sine-wave amplitude . . . ±0.5% peak-to-peak. Accuracy like this is usually associated with much larger potentiometers.

RESISTANCE RANGE IS 20K ±5% standard; 500 ohms to 50K as requested.

DESIGN OPTIONS include servo-type or tapped hole mountings, phosphor bronze bushing or ball bearings, "O" ring shaft seal when necessary, ganging up to 4 cups.

ENVIRONMENTAL SPECIFICATIONS meet MIL-E-5272A, MIL-R-19, and others as applicable when WPSC1⅛ is sealed with "O" ring.

BULLETIN SC1658 gives complete electrical and mechanical specifications. Write to Waters at Wayland.



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BOSTON POST ROAD, WAYLAND, MASSACHUSETTS

PLAN '59

PLANTS and PEOPLE

H-P Plant Has 'Forward Look'

IN STANFORD INDUSTRIAL PARK, overlooking Palo Alto, Calif., Hewlett-Packard recently settled in its new modern plant. Facility presently includes two buildings with a combined floor area of over 170,000 sq ft, and a 700-car parking lot. Company intends to expand the plant over the next few years until it has six buildings on its 40-acre site.

Each building is two stories and covers approximately an acre. The buildings adjoin at one corner and are set into the hillside to provide a truck entrance at each floor.

Plant has been designed for maximum production efficiency and economy, and for the ultimate in working conditions for the firm's 650 employees. One building is devoted almost entirely to production, while the other—the engineering building—houses the company's research and development facilities.

The upper floor of the production building includes eight production lines, a prefabrication department, shipping department, replacement stock room and production office. The latter includes accounting, production control, plant management and production engineering.

Three basic operations are maintained on the lower floor—sheet metal, finishing and plastic molding. The entire floor has been organized with a view to maintaining a continuous flow of material from shearing all the way through to stock. This flow is closely geared to demands of the production lines upstairs.

Plant noise is kept at a minimum, chiefly through extensive use of fiberglass acoustical tile in the ceilings. The saw-tooth roof also helps in absorbing noise. A system has been installed to pipe semiclassical music into the plant during alternate 15-minute periods.

Maximum natural light is provided by orientation of the buildings and liberal use of glass. Artificial light is provided by two rows of 8-ft fluorescent fixtures for each saw-tooth. To keep total light (natural plus artificial) in the work area constant, artificial lighting is controlled by a photocell system.

Hickey Chosen Galvin's Aide

FORMERLY general manager of Motorola's Semiconductor Products Division in Phoenix, Arizona, John T. Hickey was recently named assistant to the president, Robert W. Galvin, in Chicago.

In his new capacity, Hickey will be concerned with acquisitions and mergers involving companies in fields tributary to electronics, as well as other activities in the corporation's long-range growth plans.

Solomon Named To U.S. Committee

AARON SOLOMON, president of Ace Electronics, Somerville, Mass., is named member of President's Committee on Employment of Physically Handicapped.

Six-year-old firm, maker of potentiometers, employs nearly 150 persons, 75 percent of whom are disabled.

In early stages, Ace hired a few handicapped persons, as founder Solomon tested his conviction that although everyone is handicapped for some things, no one is handicapped for everything. Ability and loyalty of employees led to firm policy of hiring handicapped wherever possible.

Detailed program of selection, evaluation and placement is part of policy. Workers are paid at going rate, and company receives no tax advantage or Federal funds because of employment of handicapped.

Solomon points with pride to record of Ace employees as far as absenteeism is concerned.

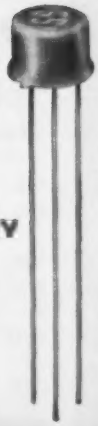
After typical New England snowstorm, he says, first ones reporting for work, waiting for plant to open, are the handicapped employees.

Advance Masurat at Philco Plant

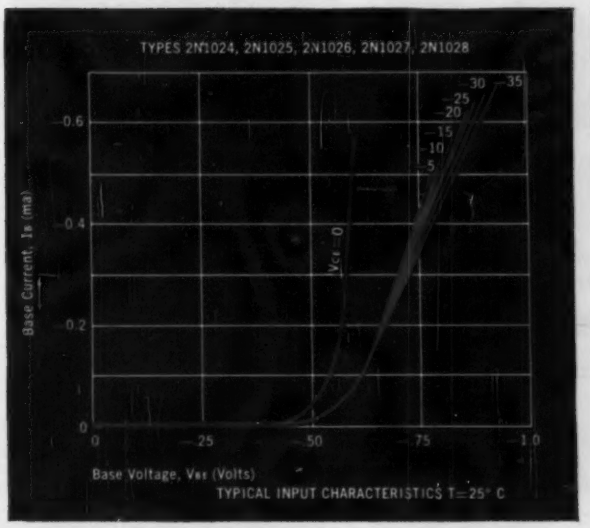
PROMOTION of George Masurat to general superintendent of production for Philco's Government and Industrial division was recently announced.

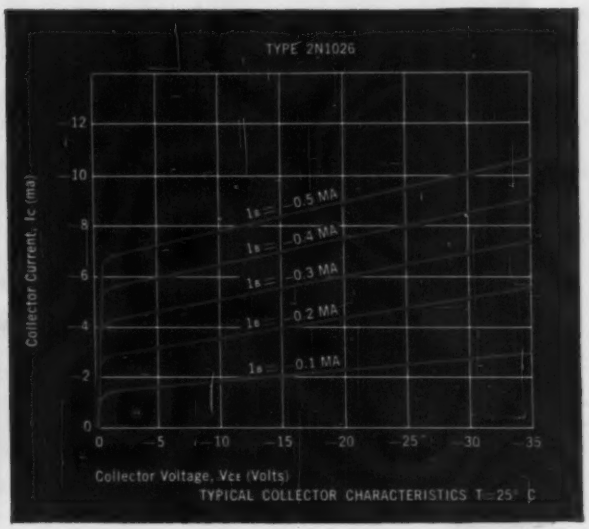
In his new position, Masurat is

NEW FROM SPERRY



SILICON PNP TRANSISTORS FOR AIRBORNE AND MISSILE APPLICATIONS





SPECIFICATIONS

TYPE	COLLECTOR VOLTAGE	BETA (h_{fe})	f_{ab}	APPLICATIONS
2N1024 2N1025 2N1026	15v 30v 35v	9 min. 9-18 18-54	1mc min. 1mc min. 2mc min.	D.C. and audio amplifiers, voltage regulation. Modulator and demodulator and switching circuits.
2N1027	15v	18 min.	4mc min.	Medium frequency--amplifier, oscillator and switching circuits.
2N1028	10v	9 min.	4mc Beta 1.8 min.	High speed computer switching.

Five new Sperry silicon transistors, made by the alloy junction process, offer important advantages for general-purpose and switching circuits in missile and airborne applications.

- **Low saturation resistance**
- **High-temperature operation**
- **Uniform input impedance**
- **High conduction**
- **150 Milliwatts power dissipation**
- **Light, ruggedized design**
- **JETEC 30 (TO-5) package for automatic assembly**

For complete electrical characteristics of these new Sperry PNP transistors, write for data sheets.

SPERRY SEMICONDUCTOR DIVISION
SPERRY RAND CORPORATION
South Norwalk, Connecticut

ADDRESS ALL INQUIRIES: *Marketing Department, Great Neck, N. Y., or Sperry Gyroscope offices in Brooklyn, Cleveland, Seattle, San Francisco, Los Angeles, New Orleans, Boston, Baltimore, Philadelphia.*

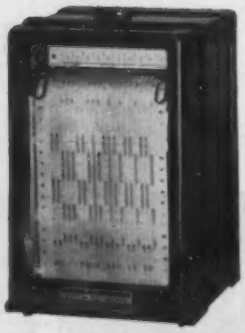
ARE THESE PROBLEMS BOTHERING YOU?

- **Productive and idle time?**
- **Flow of materials?**
- **Position of gates and dampers?**
- **Time of failure in life tests?**
- **Length of phone calls?**
- **Sequence of switching?**
- **Timing of events?**

The operation recorder will obtain the answers to these problems, and many more, for you. An instrument with 20 pens writing on a moving chart, the operation recorder shows:

- *When events occur*
- *How long they last*
- *How frequently they occur*
- *The relationship of a series of events to each other*

Ask for Catalog Section 50



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  or whatever variable AC or DC up to 1 ampere is required

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responsible for production operations of the Terrier missile fuze, Transac computers, Signal Corps radio relay equipment and Sidewinder missile.

During the past two years he was a production superintendent of the Sidewinder missile operations.

Masurat has been with Philco since 1943. He started in the Radio and Television division and in 1952 was assigned to the G and I division's field engineering staff.

Polley To Head New Division

ELECTION of Robert W. Polley as vice president of the newly-formed Flexprint Division of Sanders Associates Inc., Nashua, N. H., is announced. In his new post he will be responsible for engineering and manufacturing of Flexprint, a flexible printed wiring developed by the company.

Polley was formerly vice president of manufacturing with Nashua Corp., a manufacturer of plastic film products and laminates.

Appoint Taylor Itek Corp. V-P

THE BOARD of directors of Itek Corp., Waltham, Mass., recently appointed Norman H. Taylor a vice president. In this capacity he will direct the company's electronic R&D activities on a full-time basis.

During the past year, Taylor has been a part-time consultant to Itek

while carrying out a special engineering assignment for the Government. Prior to this he was associate division head of the Computer Division at MIT, Lincoln Laboratory, and in charge of computer development at the MIT Computer Laboratory.

Navy Award Goes To RCA

AWARD of the Navy Certificate of Merit to RCA for development of the first completely automatic missile firing and guidance system is announced.

The missile system cited by Navy Secretary Thomas S. Gates, Jr., is the TALOS defense unit, built at White Sands Proving Ground, N. M., by the missile and surface radar department of RCA Defense Electronic Products, Moorestown, N. J.

Dalmo Victor Ups Stanbury

RECENTLY named assistant to the manager of the Electronic Systems Division, Dalmo Victor Co., Belmont, Calif., is Robert J. Stanbury.

In this new post he will coordinate engineering and production progress as well as overall personnel work within the division, and will supervise cost control and employee performance.

Stanbury joined Dalmo Victor in 1950 as a research engineer. In 1955 he was named administrative engineer in the research laboratory,

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sintered plate batteries

Missiles must not fail to function instantly, on demand. NICAD Sintered Plate Batteries—with an outstanding record of proven reliability under severe environmental conditions—were chosen for use on several missiles to provide the power that guarantees ready performance.

This same reliability has made NICAD Batteries first choice in other fields where there can be no compromise with perfect function . . . on guidance systems . . . communications and data processing equipment . . . alarm and signal systems . . . aircraft engine starting

NICAD Sintered Plate Batteries are available in capacities from ½ ampere hour and feature sustained voltage at heavy discharge rates. They are capable of rapid charge acceptance . . . have a maximum discharge current up to 25 times the rated ampere hour capacity. Internal resistance is extremely low, and vibration resistance is excellent. They can be discharged in any position. Charge retention is exceptionally high, and there is no known limitation either to cycle or storage life.

NICAD Batteries are "missile quality"—delivering high level performance adaptable for a wide range of purposes.

Ask us for complete information. NICAD *Division, Gould-National Batteries, Inc.*, Easthampton, Mass, Offices in New York, Chicago, San Francisco.

NICAD **ALKALINE STORAGE BATTERIES**

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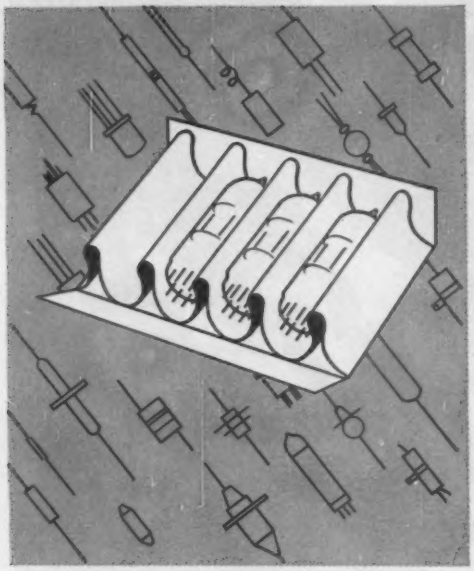
"the pack with the built-in shock absorber"



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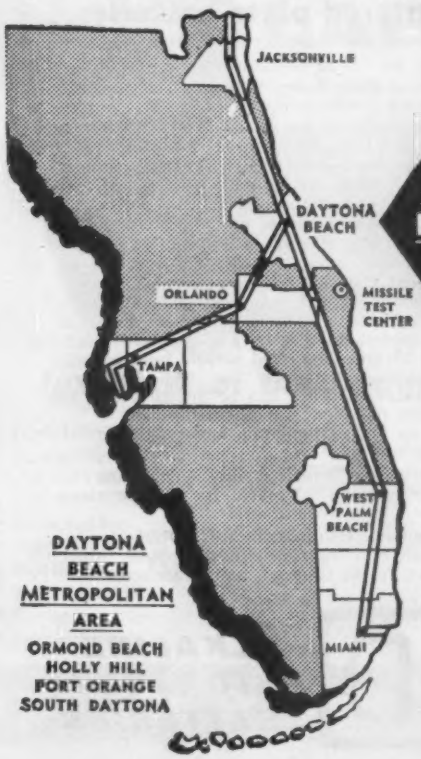

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CHAMBER OF COMMERCE
DAYTONA BEACH, FLORIDA

and in January of this year he was promoted to contract administrator in the newly-established Electronic Systems Division.

Packard-Bell Hires Howell

NEW project engineer at Packard-Bell Computer Corp. is J. V. Howell, Jr. Company is a subsidiary of the Packard-Bell Electronics Corp., Los Angeles, Calif.

Howell's first assignment will be to direct the development of a missile impact prediction system for Cooke Air Force Base, under a contract awarded Packard-Bell recently by Aerojet-General Corp., Azusa.

Prior to taking his new position he was employed in the control and simulation department of Space Technology Laboratories, a Ramo-Wooldridge subsidiary.

Plant Briefs

A new company, **CFI (Ceramics for Industry)**, is manufacturing a wide variety of precision ceramic parts and components in a 15,000-sq ft plant at Cottage Place, Mineola, N. Y.

Sequoia Wire and Cable Co., Redwood City, Calif., recently acquired Hall-Scott Electronics, Burbank, Calif.

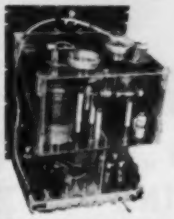
Telonic Industries, Inc., manufacturer of r-f sweep generators, moves

SPELLMAN HIGH VOLTAGE POWER SUPPLIES

MODEL LAB-60
RF TYPE
Continuously Variable 0-60 KV DC Regulated Power Supply

Current output 1 ma. at 60 KV. 2 ma. may be drawn from 50 KV to 0. Supplied with either positive polarity or negative output. Regulation stability—1% at 1 ma. 21¾" wide x 22¾" high x 18" deep.

LAB-60 Complete with meter.....$695.00 Net
LAB-60 PN Reversible polarity model of above.....$745.00 Net



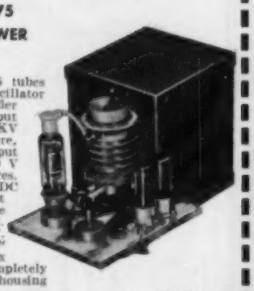
MODEL LAB-80
REGULATED DC POWER SUPPLY

Continuously variable 0 to 90 KV DC Power Supply. Output current 1 ma. at 80 KV. 2 ma. from 40 KV down. Voltage regulations better than 1% throughout voltage range. Panel dimensions 19" wide x 26" high x 18" deep.

Rear view—less cabinet

LAB-80 Complete with HV meter .....$900 Net
Specify polarity output—positive or negative

MODEL 4575
4½ KV POWER SUPPLY

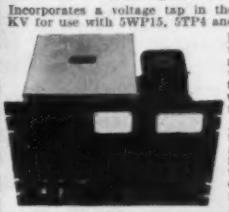


Utilizes two 6AQ5 tubes as a parallel oscillator feeding a 1X2 rectifier tube. For an output voltage of 4½ KV DC at 1 milliampere, the low voltage input requirement is 250 V at 50 milliamperes. By varying the DC input the output voltage can be varied from approx. 1 KV to 7½ KV. Dimensions: 5¾" high x 5" deep x 4¼" wide. In completely enclosed metal housing

Less low voltage DC supply .....$32.50 Net

MODEL RG-30—Continuously Variable 15-30 KV Regulated DC Power Supply with regulated focus

Incorporates a voltage tap in the range of 4 to 6 KV for use with 5WP15, 5TP4 and flying spot tubes.



Regulations better than .5% at 1 milliampere. In wide use for color tube development work, transcription recording systems.

Also available with focus and convergence voltage taps for RCA Tri-Color tubes at slight additional cost. This model can be adjusted for 40 KV output at .5 milliampere for new 40 KV projection tubes.

19½" wide x 12¼" high x 13" deep .....$295 Net
With meter installed on front panel .....$345 Net

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- **Reverse voltages to 150 volts. Forward current to 500 ma.**
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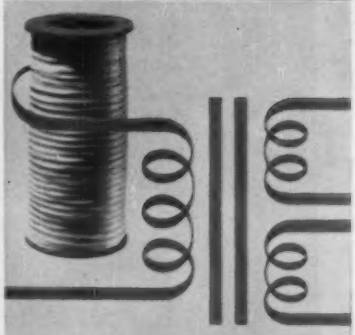

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Uses electro-sensitive chart paper. Multiple chart speeds. Response to 60 c-p-s, sensitivity 2 mv/mm. Available from one to four channel and as student model.
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$275.00 per channel for multichannel, $325.00 single channel.
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Chopper stabilized d-c pre-amp for meter movement type recorders. 10 mv across 1 megohm produces 1 ma. in 1500 ohms.
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its engineering division, Telonic Engineering Corp., to Laguna Beach, Calif. The manufacturing division continues operation in Beech Grove, Ind.

News of Reps

Four new sales reps have been appointed by Clevite Transistor Products, Waltham, Mass.:

McDowell Redlingshafer Sales Co. takes care of Missouri, Kansas, Nebraska and western Iowa.

Ray Johnston Co. covers Washington, Oregon, Idaho, Montana and British Columbia.

Glendon Co., Ltd., will handle the provinces of Ontario and Quebec in Canada.

Jack Geartner will sell the line in the state of Florida.

Erie Resistor Corp., Erie, Pa., has appointed several sales reps for various products.

James Eckersley will handle all products for the Distributor Division in the Northwest territory.

Branum Sales, Inc., will sell all products marketed by the Distributor Division in the Southwestern territory.

Harold Moyer will handle the sale of amplifier kits, a-m/f-m tuners, and ST-ERIE-O cartridges for the Mid-Atlantic territory.

Martin & Dial, Inc., will do same in Virginia.

The **G. S. Marshall Co.** of San Marino, Calif., has been appointed manufacturers' rep to handle Non-Linear Systems, Inc. digital voltmeters and associated products in the Southern California area. NLS sales will be handled by the **Gawler-Knoop Co.** in the metropolitan New York area; New Jersey; eastern Pennsylvania; Delaware; Maryland; District of Columbia; and parts of Virginia.

Phil Goldstein was recently appointed sales engineer in the Philadelphia office of **Eastern Associates, Inc.,** electronics engineering reps.

Maury Farber Associates will handle the product line of American Microphone Mfg. Co., Rockford, Ill., in upstate New York.

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See R. E. Anderson's AIEE papers, "Magnetic Amplifier Design," C & E, May 1958 for performance details. Limited number of reprints of this paper available, write us for your free copy.

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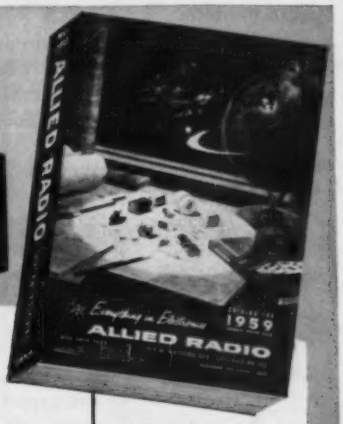

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NEW BOOKS

Analysis and Control of Nonlinear Systems

By Y. H. KU.

The Ronald Press Co., New York, 1958, 360 p, $10.00.

THOUGH the rapid development which has characterized the field of electrical engineering in recent years has focussed attention on the problems connected with nonlinear systems, the number of books dealing with this subject from the point of view of the engineer has up to recent date been pitifully small. Thus, the publication of Dr. Ku's volume is an event of importance to engineers, not only because the author is one of the foremost investigators in the field of nonlinear systems but also because he has written a well-organized and up-to-date book.

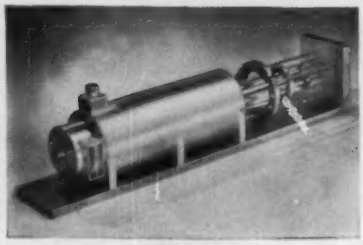
Roughly the first half of the book deals with the methods used to study phenomena occurring in first and second order nonlinear systems. All the known methods for obtaining approximate solutions of both autonomous and forced systems are described and illustrated by well-chosen, completely worked out numerical examples. The third quarter of the book deals with the analysis of higher order systems. In these chapters the author presents his powerful extension of the phase-plane method and the phase-space method. The last part of the work deals with the analysis and control of nonlinear feedback systems.

There are several techniques which the author successfully employs to give clarity to the exposition. As mentioned above, the analytical procedures are well illustrated with practical examples. The important results are pinpointed by precisely stated theorems. Appropriate discussion contrasting the behavior of linear and nonlinear systems is presented in proper perspective. Thoughtfully selected problems are appended to each chapter, making this book a suitable text for graduate and senior students. A chronological bibliography consisting of 733 references provides full documentation.

While the presentation of sub-

PROBLEM

Reduce costs in high powered TACAN systems



SOLUTION

J-V-M Tetrode Cavity

Here is a typical example of J-V-M Microwave Company's ability to coordinate its engineering experience and facilities with those of equipment, component and tube manufacturers. This L-Band tetrode cavity is considerably less expensive than the klystron which it is designed to replace. The cavity is for operation in the 900 to 1250 megacycle range. It employs the latest advancement in high powered tetrodes.

Many other tube-cavity combinations, including airborne, and a wide variety of other microwave components...antennas...wave guide adapters...mixers...multipliers...duplexers...etc....can be supplied to your specifications. We have complete design, engineering, manufacturing and testing facilities. Our expert microwave engineers will work in close coordination with you from blueprint to actual installation.

Tell us about your requirements. Ask for information and/or quotations on any microwave component. Let us prove that we can give you complete satisfaction—and save you time, money and manpower. Request catalog on our full line of standard items.

J-V-M

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ject matter per se leaves nothing to be desired, this reviewer is most impressed with the consistent philosophy underlying the presentation. The author recognizes the three stages through which understanding of physical systems progresses: analysis of linearized systems, analysis of nonlinear systems and synthesis of nonlinear systems. In connection with feedback control systems, the author summarizes: ". . . In short the newest aspect of feedback control is the development of the theory of nonlinear control! Remove the artificial limit (boundary) X of linear control! All Nature's secret possibilities are available to help the feedback."

Thus we have arrived at the third stage; linear and nonlinear elements can be used to control system performance. The integration of nonlinear and linear devices, once the effects of both can be completely evaluated, allows the full exploitation of all physical phenomena.—EGON BRENNER, *The City College of N. Y., New York 31, N. Y.*

The Computer And The Brain

By JOHN VON NEUMANN.
Yale University Press, New Haven, Connecticut, 1958, 82 p. $3.00.

JOHN VON NEUMANN, one of the renowned mathematicians of our time, had been scheduled to deliver the Silliman Lectures, at Yale University during the spring of 1956. His untimely death, and severe illness which preceded his death, made both the delivery of the lectures, and even the completion of the manuscript, an impossibility. The unfinished, and fragmentary manuscript he had been working on has been published however and provides, even in its incomplete form, a stimulating introduction to a topic which must inevitably be of increasing interest not only to engineers, but to mathematicians, neurologists, psychiatrists and laymen alike.

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October 15, 1958

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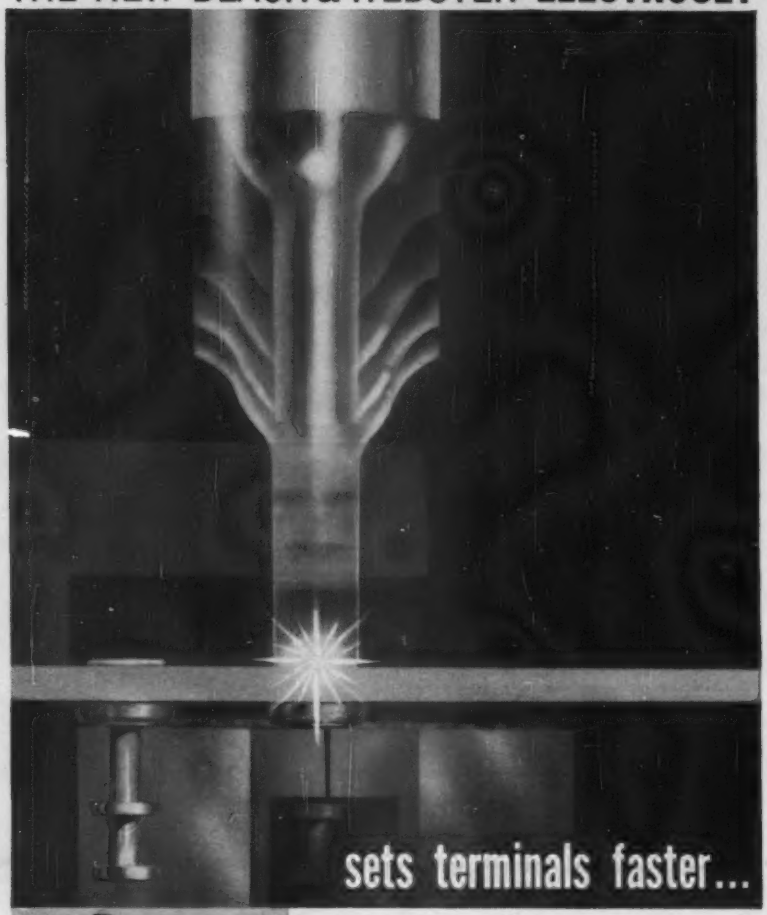

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point of view" and was to have drawn from "that body of experience which has grown up around the planning, evaluating and coding of complicated logical and mathematical automata", the prime examples of which are the large electronic computing machines.

The manuscript, as published, is quite brief. Approximately the first half is devoted to an introduction to, and survey of, both analog and digital computers. The last half is devoted to a discussion of the nervous system and to a comparison of some aspects of the nervous system to corresponding aspects of modern computers. The questions of size, speed and dissipation are discussed. After reading this section, one is left marvelling at the remarkable efficiency of the brain.

For this reviewer, however, the brief discussion of precision seemed to hold the most far-reaching implications. Due to the logical depth, i.e., the very large number of cascaded steps, of modern digital computers and the resulting accumulation of errors which are introduced, it is necessary to carry through the machine a very high precision, of perhaps 12 decimal places, even though the input data may frequently be known to perhaps only three or four places.

The nervous system on the other hand transmits information by using essentially a sort of frequency modulated pulse train, a system which is inherently of low precision (but high reliability).

The inference to be drawn is that the nervous system somehow manages its extremely complex operations with much less logical depth.

We are thus led to conclude that the language utilized by the brain, in both its logic and mathematics, must differ considerably from those languages to which our normal experience refers. This leads to the final conclusion that, as mathematics is applied to the study of the brain, not only will broader understanding of the brain result, but very probably knowledge of the brain will effect our understanding of mathematics.—JACK HAHN, *Pupin Lab., Columbia University, New York, N. Y.*

(Continued on page 176)

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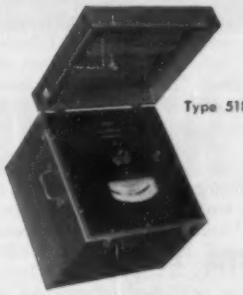

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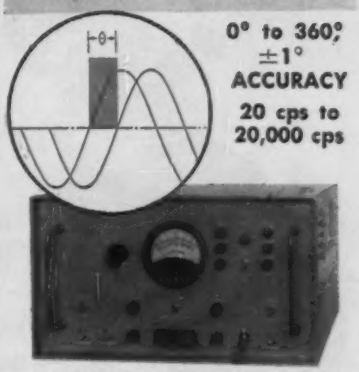

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THUMBNAIL REVIEWS

Principles of Electronics. By R. H. Krackhardt, Ronald Press Co., New York, 1958, 276 p, $7.50. This introductory textbook for sophomore or junior level electrical engineering students sets forth the basic scientific principles which underlie all electronic systems.

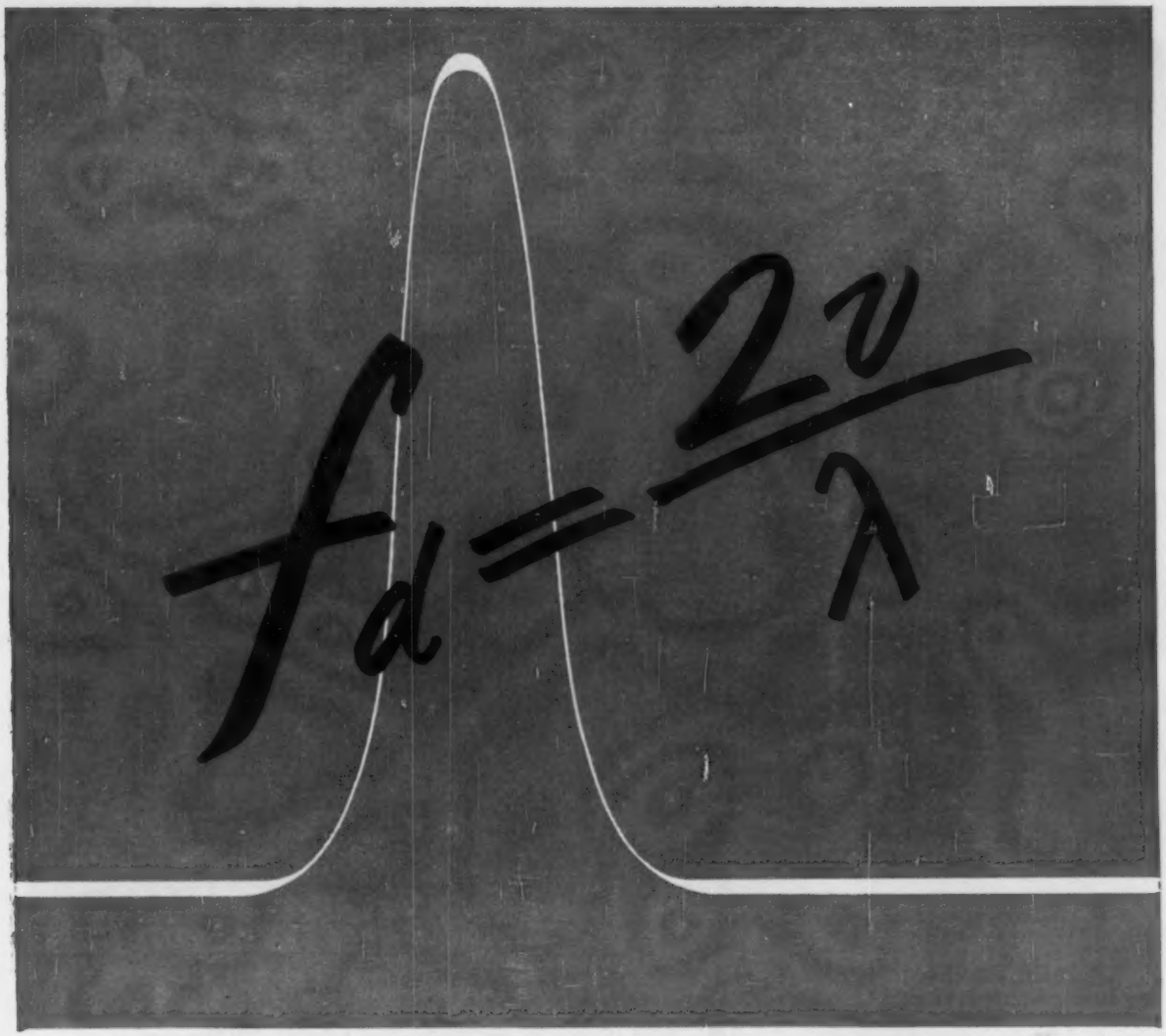
Electric Contacts Handbook. By R. Holm, Springer-Verlag, Berlin, Germany, 1958, 522 p, DM52.50. This completely rewritten third edition of "Die technische Physik der elektrischen Kontakte" should be of value to those concerned with circuit breakers, relays, terminals, microphones, current collectors, commutators and other devices that operate with electric contacts. Among the topics covered are construction and film resistance; friction and wear; commutation; arcs, arc quenching and material transfer in switching contacts.

Mathematics for Science and Engineering. By P. L. Alger, McGraw-mill Book Co., Inc., New York, 1957, 360 p, $6.95. Designed for self-study, this text covers mathematics from the elementary school to college level. Emphasis is placed on complex numbers, infinite series and methods of approximation.

Fluorocarbons. By M. A. Rudner, Reinhold Pub. Corp., New York, 1958, 238 p, $5.75. General properties and chemistry of fluorocarbon materials such as (Teflon, Fluorothene, etc.) are covered along with processing techniques. Of particular interest to the electronic engineer are the chapters on "Effects of Fabrication on the Properties of Teflon" and "Electrical Applications". The latter covers crystal and tube sockets, connectors, insulators and other components.

Bibliography of Radio Noise and Interference. By C. D. Lunden, International Electronics Engineering Inc., 425 13th St. N.W., Washington 4, D. C., 257 p, $12.00. Detailed guide to published information on factors that degrade signal-to-noise ratio in electronic systems.

Accounting Guide for Defense Contracts. By P. M. Trueger, Commerce Clearing House, Inc., 522 Fifth Ave., New York, N. Y., 2nd Ed., 1958, 464 p, $12.50. What to look for, what is required, what the government expects in cost accounting record and its position on allowable and unallowable items are some of the subjects covered in this handbook along with stretch-outs, terminations and cutbacks of production contracts, and public vouchers under cost-fee contracts.



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COMMENT

Noisefree Enclosure Openings

Two aspects of the article "Designing Noisefree Enclosure Openings" (p 48, Aug. 29) should be clarified in order to make the article more useful.

In the first sentence, Mr. Arnold Albin states that "Openings for control shafts, meters and ventilation may permit radiation of electromagnetic energy from transmitters . . ." etc. This is certainly true, but the waveguide-attenuator aperture proposed by Mr. Albin is difficult to apply to a control shaft. Of course, if the control does not have to be changed often, it may be screwdriver-adjusted, with an access aperture of the type described for the screwdriver. However, if the shaft is to be continuously controllable from outside the unit, it must run *through* the aperture. With a metallic shaft the system then becomes a coaxial line, with excellent energy propagation in its characteristic TEM mode. Some improvements may be gained if an insulating shaft is used, but the high-frequency dielectric line formed by the shaft will permit an outward flow of energy appreciably higher than that predicted by waveguide-attenuator theory.

A procedure familiar to the writer for reducing r-f leakage when a shaft runs through a panel is to utilize a concentric spring-finger ground to the shaft at the panel. For microwave equipment of relatively narrow bandwidth, a panel bearing may be fabricated in the shape of a noncontacting choke.

The second point concerns the lower-frequency limit of the published curves. The curves are valid down to zero frequency. In one particularly important application, they hold for radiation fields at power-line frequencies.

EUGENE H. KOPP
MONTEREY PARK, CALIF.

Author Albin likewise noted the second point:

While your editor was quite accurate in his condensation of my article . . . I would like to point out that in theory, the curves actu-

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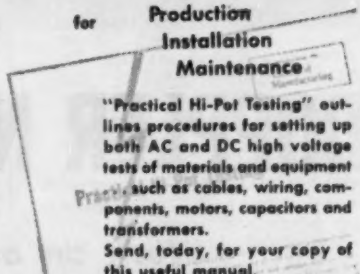

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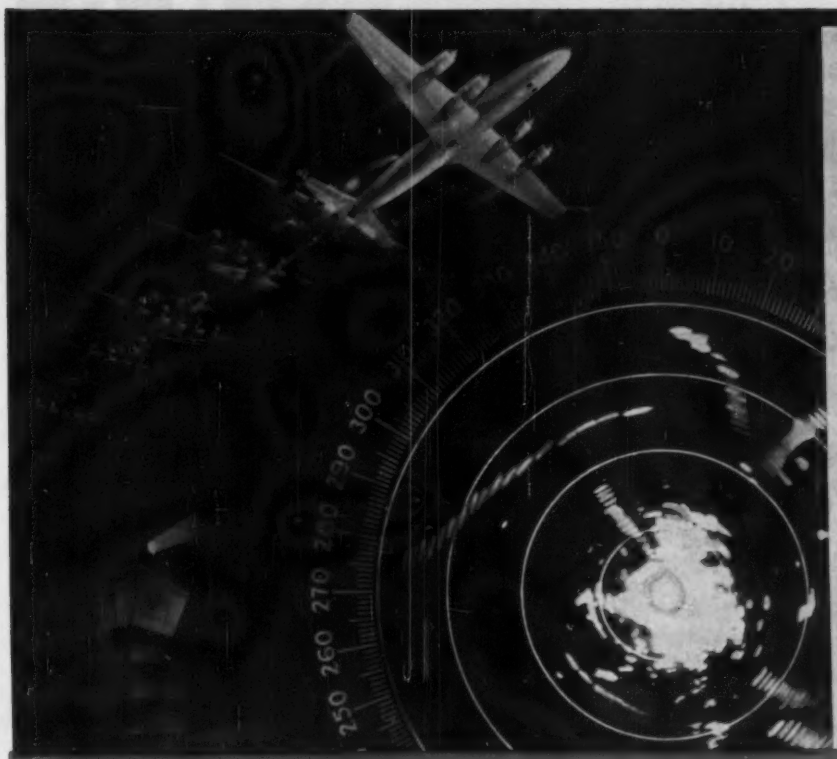

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The author also extends an invitation to readers who would like either reprints of the article or copies of the original paper with full-size design curves, to write him at the address above.

Magnetic Gage

The lead position given "Magnetic Gage Locates Encased Metal Parts" (p 65, Aug. 15) was pleasing to all hands here. Also, your handling of the material drew compliments from the author.

However, there was one flaw which we hope can be rectified. The line was omitted in which credit was given to staff members who participated in this program.

James W. Dempster and William Roehr, respectively, designed the mechanical and electronic features of the magnetic concentricity gage described in the article. They were assisted by Howard W. Mabus, Roy F. Hurst, David E. Brink, Weston B. Farrand and Paul E. Seaward, all of Stanford Research Institute's Poulter Laboratories.

Charles Elkind
Stanford Research Institute
Menlo Park, Calif.

Dissipation Chart

Albert L. Hedrich, chief engineer of Weinschel Engineering, has called my attention to an error of labeling of the R_2 and R_3 curves in my paper "Dissipation Chart for T Attenuators" (p 92, June 20). Correctly, R_2 and R_3 should be interchanged at the curve, and W_{D2} and W_{D3} alone should also be interchanged.

The error of drafting is mine. For those who would avoid such errors, all I can say is that it was a pitfall of deriving the expressions with one nomenclature and then translating them to more conventional terms.

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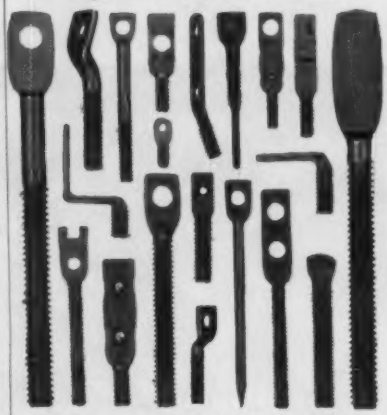

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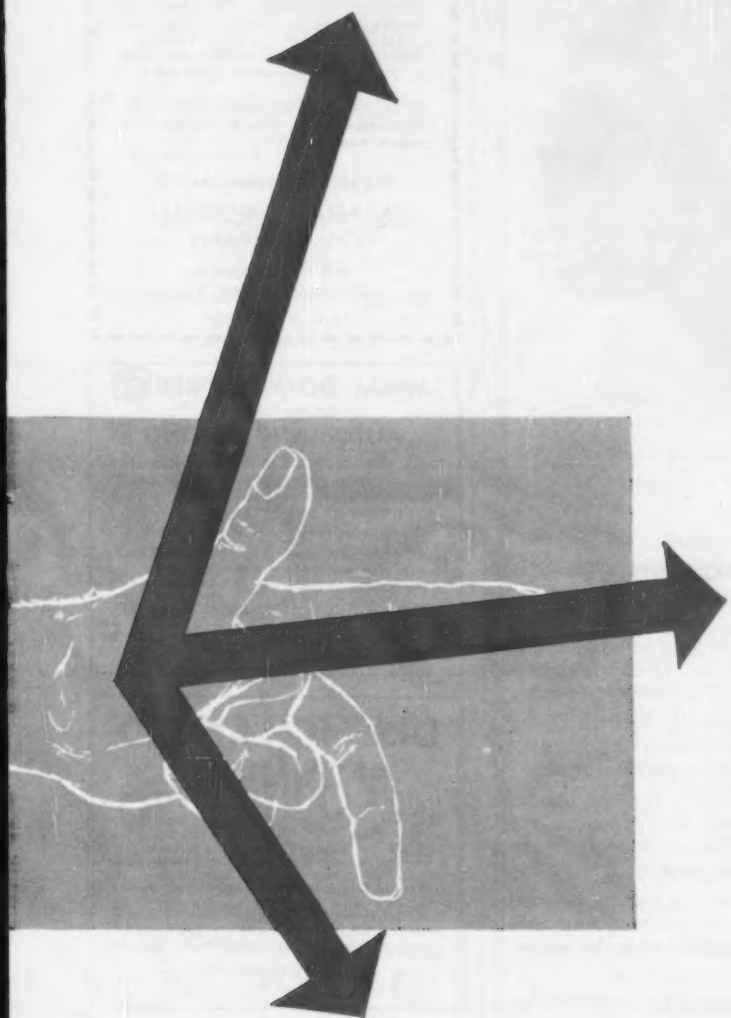

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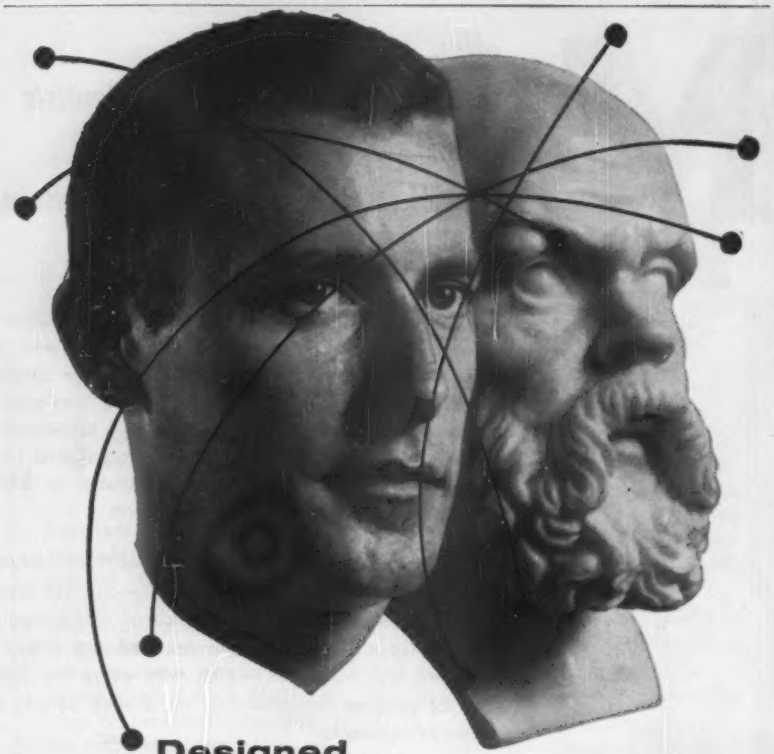

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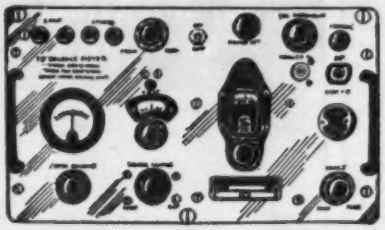

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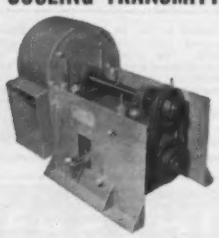

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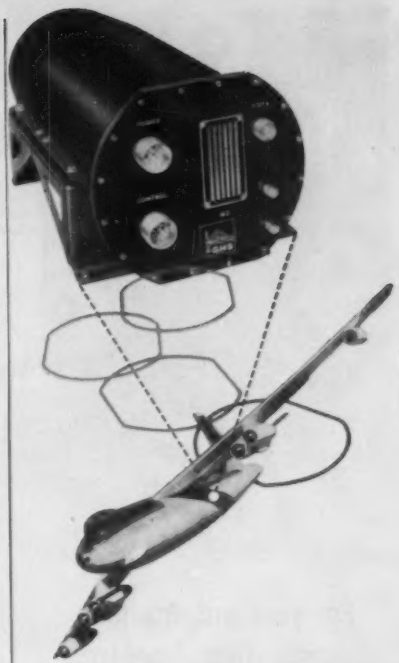

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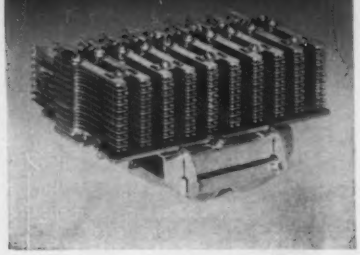

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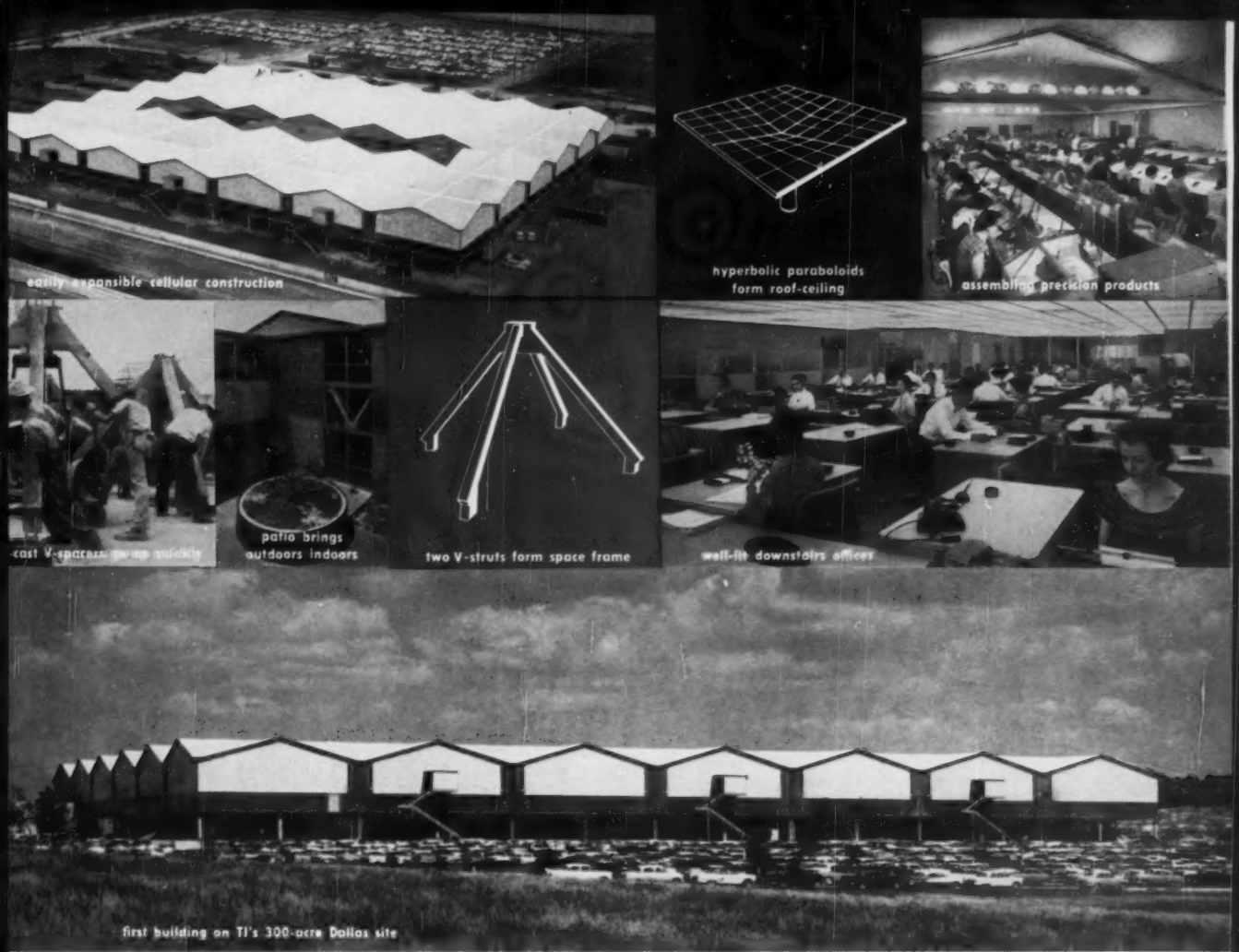
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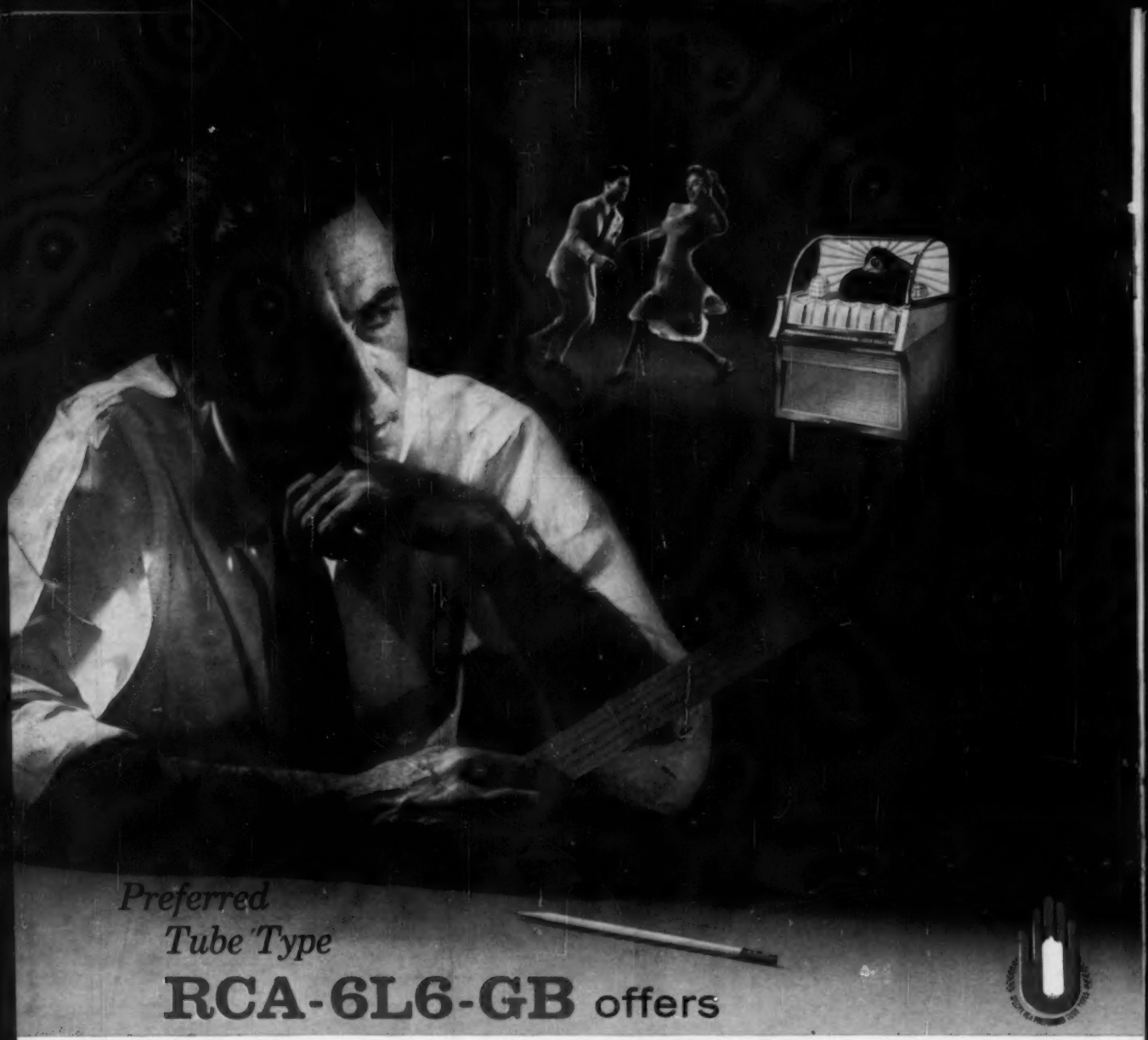

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